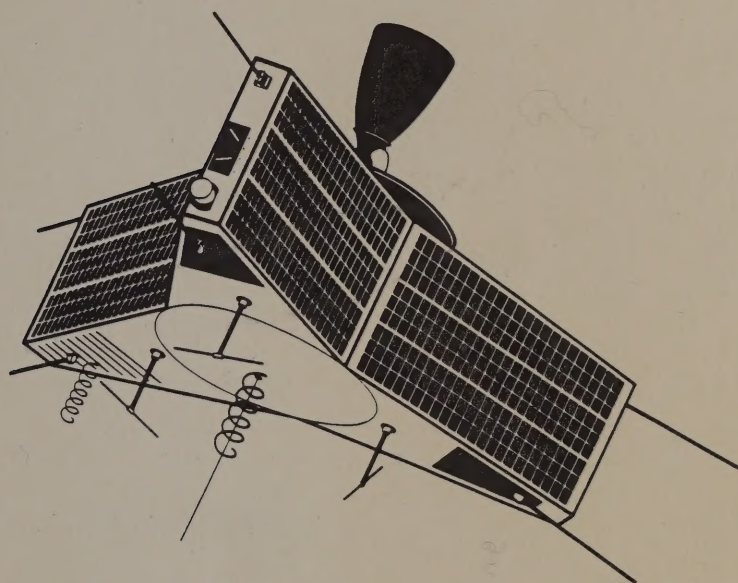


A Beginner's Guide To OSCAR-13

A step-by-step guide to hardware and operating procedures
necessary to work the World through OSCAR-13



by
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I. INTRODUCTION

Imagine the prospect of working worldwide DX with modest antennas and low power. With a complete disregard for sunspots and the ionosphere, you'll leisurely ragchew with VK's, KH6's, DL's, and other DX. And most amazingly you can do it on frequencies that we normally think of as "line of sight".

The night that I finally managed to get all the pieces to fit together and made my first satellite QSO was one of the most magnificent moments I remember in Amateur Radio ; very similar to my first Novice CW QSO (We all remember that!). With a small homebrew antenna, weighing under three pounds, and 10 watts, I was talking to stations in Portland, Oregon and Sydney, Australia, at the same time! Their voices were clear, and they were extremely friendly people. I have read, as I am sure you have, about the old days in amateur radio when all Hams were friendly; they welcomed you to get on the band and to join their QSO if you wished. Those days don't seem to exist on the crowded HF bands anymore. However, with OSCAR-13, that "spirit" of Ham Radio still exists. With as much bandwidth as the 15 meter HF band, there is always room for your QSO and there are plenty of people willing to give you any help that you may need.

The purpose of this booklet is to try to provide you with my (and other peoples') experiences that have resulted in successful operation on AMSAT OSCAR-13. This is not to say that the way presented here is the best way; other ways may work equally well. This is simply one way that has worked for many now operating successfully on the satellite.

II. AMSAT

AMSAT is a word that you are going to hear a lot in dealing with Amateur Satellites. AMSAT is an acronym for the Radio Amateur Satellite Corporation. AMSAT is a non-profit, tax-exempt, 501(c)(3), scientific and educational corporation.

As you can imagine, building and placing an amateur satellite into orbit is a very expensive proposition. Even though a lot of contributions from corporations, individuals, and "free rides" are available, AMSAT must spend a pile of money to build, launch, and control modern amateur satellites. They don't have a large paid staff; it's just people like me (and hopefully you) who volunteer their time and money to support the amateur satellite program.

One of the primary benefits of belonging to AMSAT is their publication, AMSAT-NA Journal. This is a very informative publication that gives you the latest happenings of amateur satellites and satellite communications. In addition to The Journal, there are many other ways to find out about the amateur satellite program. There is a whole army of AMSAT Regional and Area coordinators. These "Elmers" are volunteers who will be happy to help you with getting on the "bird". A list of these people can be found in the Appendix of this document. Another source of information is to tune in on your local VHF or HF net. These nets have the latest "news" as well as technical help sessions. A list of these nets is also found in the Appendix.

I strongly encourage you to join AMSAT and be an active supporter of it. Without AMSAT there would not be an amateur satellite program.

PLEASE SUPPORT AND JOIN AMSAT.

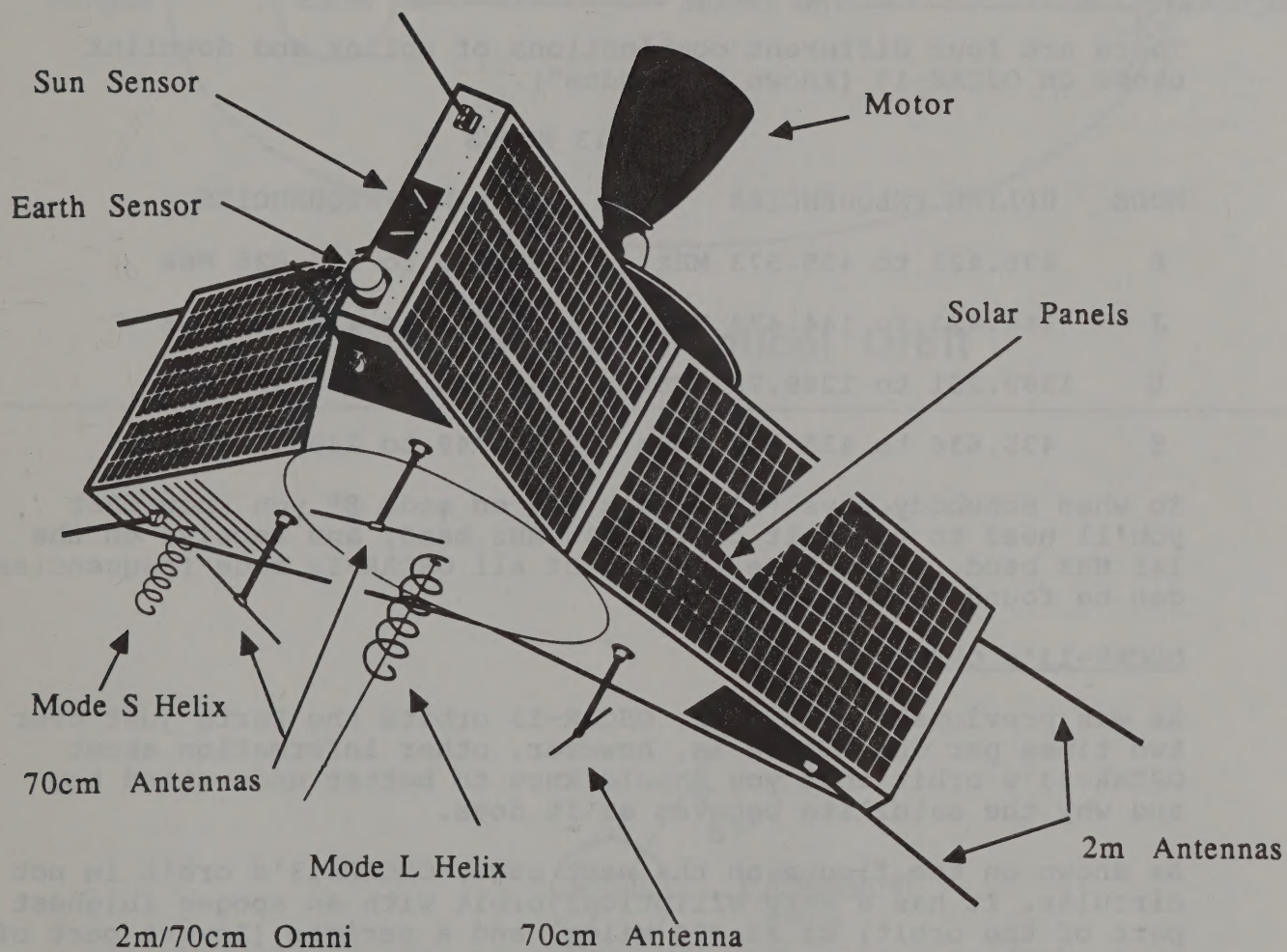
For more information about AMSAT write (with S.A.S.E) or call

AMSAT
P.O. BOX 27
WASHINGTON D.C. 20044
(301)-589-6062

III. What is OSCAR-13 Anyway?

OSCAR-13 is an acronym describing the thirteenth Orbiting Satellite Carrying Amateur Radio. Simply put, OSCAR-13 is an orbiting platform carrying five different types of repeaters or transponders that operate on amateur radio frequencies. These transponders can be freely used by anybody licensed to use the frequency. All transponders on OSCAR-13 can be used by holders of a Technician class (or higher) license.

OSCAR-13 is orbiting the earth at just over two orbits per day in an egg shaped "Moniya" orbit. At its furthest point from the Earth (apogee) the satellite is over 36,000 kilometers high. If you can remember some of the NASA photographs of the Earth from the Space Shuttle, you can imagine how OSCAR-13 "sees" the Earth. At apogee, the satellite can see virtually half of the world at a time. This is very important from a communications standpoint. If OSCAR-13 is in view of your QTH, you can talk through the satellite to any other area it sees at that time. This is exactly the same thing as the area of coverage of your local 2-meter repeater. If you and another station are in the coverage area of the repeater, then you can communicate. Usually, the higher the repeater, the better the coverage. Imagine the coverage of a repeater that's up 22,000 miles!!!!.....



What is a Transponder?

As you probably know, on your local 2-meter repeater there is one transmit and one receive frequency (usually separated by 600 KHz). As long as you know where to transmit and where to listen, you can communicate with others through the repeater. A linear transponder, on the other hand, receives RF over a wide segment of a band, amplifies it, shifts the whole segment to another band, and then retransmits it. In the case of the Mode "B" transponder on OSCAR-13, the satellite receives all frequencies between 435.420 to 435.570 MHz and retransmits the whole passband on 145.975 to 145.825 MHz.

There are four different combinations of uplink and downlink bands on OSCAR-13 (known as "modes").

OSCAR-13 MODES

MODE	UPLINK FREQUENCIES	DOWNLINK FREQUENCIES
B	435.423 to 435.573 MHz	145.975 to 145.825 MHz
J	144.423 to 144.473 MHz	435.990 to 435.940 MHz
L	1269.351 to 1269.731 MHz	436.005 to 435.677 MHz
S	435.636 to 435.602 MHz	2400.749 to 2400.715 MHz

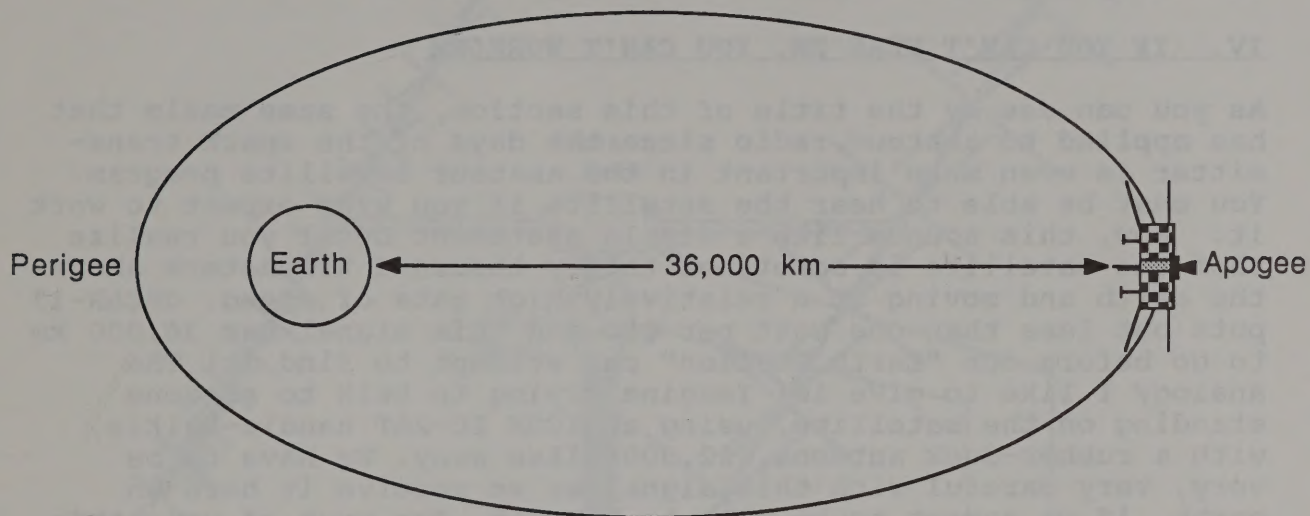
So when somebody says "I'll work you on mode B" you know that you'll need to transmit on the 435 MHz band, and receive on the 145 MHz band. A complete listing of all OSCAR-13 mode frequencies can be found in the appendix.

OSCAR-13's ORBIT

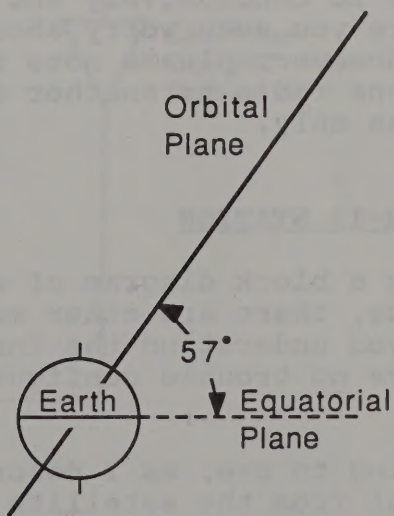
As was previously mentioned, OSCAR-13 orbits the Earth just over two times per day. There is, however, other information about OSCAR-13's orbit that you should know to better understand how and why the satellite behaves as it does.

As shown on the figure on the next page, OSCAR-13's orbit is not circular. It has a very elliptical orbit with an apogee (highest part of the orbit) of 22,000 miles, and a perigee (lowest part of the orbit) of 3,500 miles. The orbit is tilted, with respect to the earth's equator, 57 degrees.

The satellite is stabilized by spinning at 30 revolutions per minute. The reason that it needs stabilization is to keep the solar panels pointed somewhat at the sun, and, as will be discussed later, to keep the satellites antennas pointed at the earth.



OSCAR-13's Elliptical Orbit



OSCAR-13's Inclination

Well, on to the reason why you are reading this, and that is, how to set up a station capable of working OSCAR-13.

IV. IF YOU CAN'T HEAR'EM, YOU CAN'T WORK'EM

As you can see by the title of this section, the same maxim that has applied to amateur radio since the days of the spark transmitter is even more important in the amateur satellite program. You must be able to hear the satellite if you ever expect to work it. Now, this sounds like a simple statement until you realize that the satellite is sometimes thirty thousand kilometers above the earth and moving at a relatively high rate of speed. OSCAR-13 puts out less than one watt per QSO and this signal has 36,000 km to go before our "Earth Station" can attempt to find it! The analogy I like to give is: Imagine trying to talk to someone standing on the satellite, using an ICOM IC-2AT handie-talkie, with a rubber-duck antenna, 22,000 miles away. We have to be very, very careful with this signal as we receive it here on earth, if we expect to be able to hear it. For most of you, this will be your first exposure to VHF/UHF "weak signal work".

THIS IS MOST PEOPLE'S BIGGEST PROBLEM ON OSCAR-13; they aren't able to receive the satellite at a level they can repeatably copy. They hear it, but it doesn't raise their S-meter above zero. This is why this section comes first. I want to encourage you to spend your money and your time to concentrate your efforts on first being able to conclusively and with repeatability hear the satellite before you even worry about trying to uplink and talk through it. However, please note that S-meter readings usually vary from one radio to another and should be used for comparative purposes only.

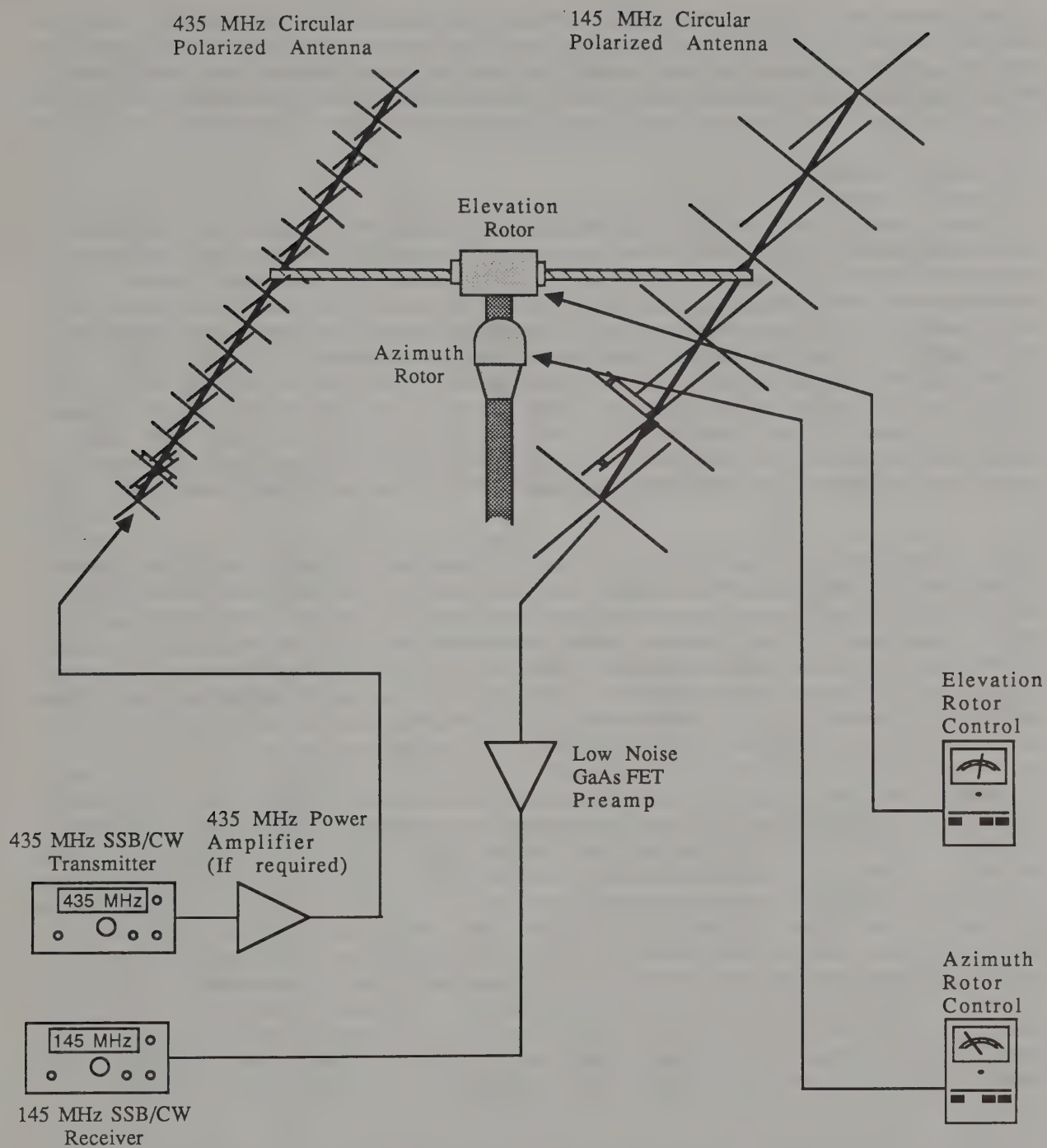
V. A TYPICAL OSCAR-13 STATION

On the next page is a block diagram of a typical mode "B" station. As you know, there are other modes available on the satellite, but if you understand the ins and outs of a mode B station, you'll have no trouble configuring your station for the other modes.

The format I am going to use, as I describe a mode B station, is to follow the signal from the satellite to the receive antenna, down to your receiver, and then from your transmitter to your transmit antenna. So here goes:

1. Antennas and Antenna Placement

Antennas used to communicate through OSCAR-13 are probably different than any you've ever used before. As with HF or VHF, a well thought out, well placed antenna installation will make or



Mode "B" Station Block Diagram

break your station. But with satellite work you've got to switch gears (so to speak) from traditional antenna thinking. Bigger is not necessarily better, higher is not a high priority, and the polarization is usually neither vertical NOR horizontal. Confused ? Don't be. Lets take this one step at a time.

Antenna Polarization

If you try to use either a vertically or a horizontally polarized beam antenna (like the ones you may presently be using for 2-meter FM or SSB operation) you will probably find that the spacecraft may impart a very objectionable "flutter" (spin modulation) on the signal and that the signals that you do hear will not be real strong. The only stations that I have consistently worked who use linear polarization are Moon-bounce stations! I think these guys have just a few more dB of antenna gain to spare than you or I. I strongly recommend that you use antennas capable of circular polarization. If you don't, you'll throw away hard earned transmitter and receiver performance.

Basic antenna theory says that circular polarization comes in two "flavors"; right-hand circular polarization (RHCP) and left-hand circular polarization (LHCP). As you know, if you are talking with a station whose antenna is vertically polarized, then, in order to receive him best, your antenna should be vertical also. Likewise for horizontal polarization. If you are "cross-polarized", then the receive signal will be very attenuated. The same rule goes for CP antennas, RHCP wants to talk to RHCP and LHCP wants to talk with other LHCP antennas.

If they had put linear antennas on OSCAR-13, then, the spinning spacecraft would be cross-polarized to you much of the time! The rapid rising and falling of the signal would make communications nearly impossible. Fortunately, they put right-hand circularly polarized (RHCP) antennas on the bird. Let's just say that if you are pointing your circularly polarized antenna at the satellite, and the satellites antennas are pointing at you, then it doesn't matter if it spins or not; the signal will be the same.

The ability to switch from RHCP to LHCP is nice, but not absolutely necessary. The great majority of the time, RHCP is all that's needed. Don't place the capability to remotely switch polarizations too high on your priority list.

There are two major types of circularly polarized antennas commonly used in amateur satellite communications. By and large, the antenna that the vast majority use is the Crossed Yagi. A strong second is the Helix antenna.

A crossed yagi can be thought of as two identical regular yagis sharing a common boom. The elements are crossed to form the familiar "X" shape. Circular polarization is generated when one

of the driven elements is fed one quarter of a cycle (90 degrees) later than the other. The Helix antenna, when wound like a normal-right hand screw, automatically produces right hand circular polarization. Note that the polarization of the helix is not reversible.

As a general rule of thumb, you should select a 2 meter antenna capable of about 10 dBd gain or greater. This boils down to a crossed yagi having at least 8 elements in each plane. On the 70 cm antenna, used for the uplink, a gain of 12 dBd would be nice. Consider, however, that in operating mode B, you can make up for low antenna gain by simply increasing your transmitter power. On the other hand, if you ever want to use the antenna for receiving mode J or L it's nice to have an antenna with a fair amount of gain.

There are many commercially available antennas that will fit the bill. A list of quite a few of them can be found on the next page.

I don't think that you can go wrong with any of the "store-bought" antennas found on the next page, however, don't be afraid to homebrew your own. My personal experience has proven that you can walk into a well equipped hardware store, and, for twenty dollars or so, walk out with all the materials you need for a perfectly adequate antenna. Other places to find parts include your local welding supply, scrap metal yard, and plumbing supply. It is beyond the scope of this document to go into a long discussion on homebrew antennas, but lets just say that there are a few publications that do address the topic. Most notable among these are The Satellite Experimenters Handbook, The ARRL Antenna Book, and The ARRL Handbook. Also, keep an eye out in most of the popular Ham Magazines. They'll have good antenna articles from time to time.

A final thought on homebrewing your own antennas; almost any good Yagi antenna design can be adapted to circular polarization. If you just construct two of the design on a common boom and then feed them with a simple homebrew phasing harness, you'll be in business.

COMPARISON TABLE OF COMMERCIALY AVAILABLE ANTENNAS

MANUFAC-TURER	MODEL NUMBER	DESIGN FREQ. (MHz)	ADVER-TISED GAIN	POLAR-IZATION	TOTAL NO. OF ELEMENTS	LENGTH (Feet)	ADVER TISED COST
KLM	2M-14C	144-150	11.0 dBd	Note 1	14	12.7	\$152.00
KLM	435-18C	420-450	12.0 dBd	Note 1	18	7.3	\$199.00
KLM	2M-22C	144-150	12.5 dBd	Note 1	22	19.1	\$196.00
KLM	435-40CX	420-440	15.2 dBd	Note 1	40	14.6	\$232.00
Cushcraft	A-14420T	145.9	12.2 dBd	Note 2	20	11.0	\$ 86.00
Cushcraft	416-TB	435	12.5 dBd	Note 2	16	7.5	\$ 76.00
Hy-Gain	216-S	145.9	11.5 dBd	Note 1	16	14.2	\$139.95
Hy Gain	217-S	435	14.0 dBd	Note 1	30	10.2	\$119.95
J-Beam	10XY/2M	145	11.3 dB	Note 3,4	20	11.8	\$ 83.00
Tonna	2 X 19el	435	14.1 dB	Note 1	38	9.9	\$ 75.00
Tonna	2 X 9	145	11.0 dB	Note 1	18	11.9	\$ 86.00

NOTE 1: Polarization is remotely switchable for either Right Hand Circularly Polarized or Left Hand Circularly Polarized.

NOTE 2: Is either Right Hand or Left Hand Circularly Polarized. Polarization is not remotely switchable.

NOTE 3: The PMH-2C phasing harness must be purchased with the antenna in order to produce circular polarization.

NOTE 4: J-Beam distributed by Spectrum International, Concord, Mass. (508) 263-2145

Antenna Placement

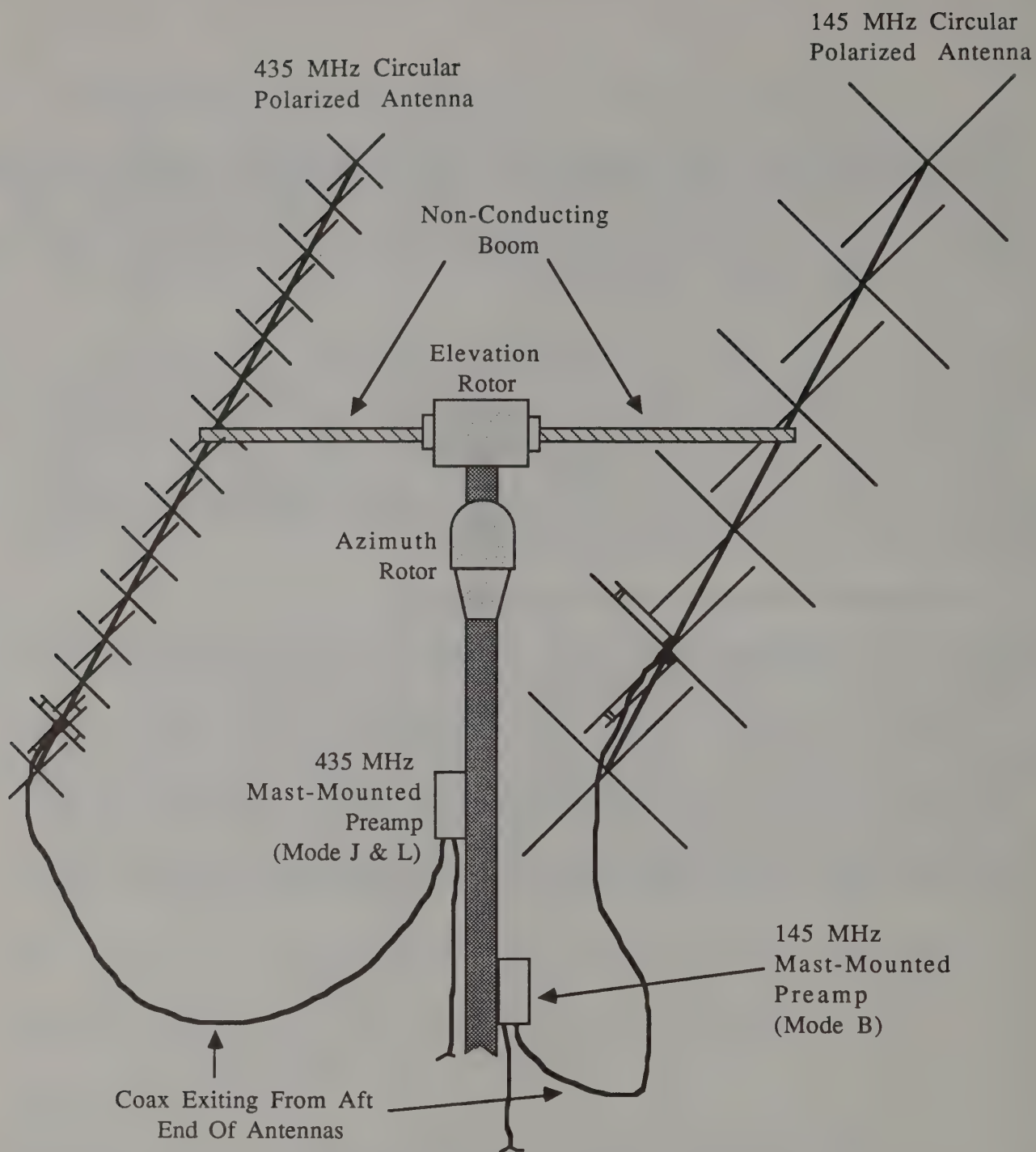
The first thing to keep in mind is that the satellite you are working through is "line of sight". If you had a very powerful telescope you could SEE the satellite. As long as your antennas have a reasonably clear shot to the horizon they don't have to be very high at all. With OSCAR-13 22,000 miles out in space, what will it gain you to have your antennas an extra 25 feet closer to the satellite? A friend of mine, surrounded by the 120 ft. piney woods of east Texas, does fine with his antennas up only 16 feet. There is probably some attenuation by the trees, but," ya jest do the best with what'cha got".

Also, low antennas have many other advantages. The primary advantage is that the feedlines to the receiver and transmitter are kept short, and short means less loss of an already weak signal. (More on feedline later) Other advantages of keeping the antennas low are that they are easy to work on and they are low profile. The latter is important to folks in areas sensitive to tall antenna installations.

The usual satellite antenna location that I've seen has the antennas placed on a 10 or 20 foot push-up-pole, or many use two sections of Rohn-25 tower. Still others use a five or six foot roof-mounted tripod. Placing your antennas above the existing HF antennas is certainly a good option, and I have seen this done successfully many times. However, weigh the convenience of doing this against the length of feedline required. Carefully analyze the situation at your QTH and, after reading this booklet, make the decision that is best for you.

2. Elevation/Azimuth Positioning Systems

Whichever antennas you choose, and wherever you decide to place them, they must be accurately pointed toward the satellite. Therefore, you need the ability to change both the azimuth and elevation on your antennas. As you probably know, azimuth is the measure of where you are pointed on the horizon. 0 degrees is North, 90 degrees is East, 180 degrees is South, and 270 degrees is West. Elevation is the measure of how high in the sky you are pointed. 0 degrees is on the horizon and 90 degrees is straight up. The ARRL Antenna Book and 1989 ARRL Handbook are very good references for these systems so please consult them thoroughly.



**Typical OSCAR-13 Mode J & B
Antenna Installation**

The majority of OSCAR-13 users use separate, dedicated azimuth and elevation rotors mounted 15 to 20 feet up. There are, however, other ways. You may choose to use a manual system for positioning your OSCAR-13 antenna array. Please review the computer printout provided in the Appendices showing the actual azimuths and elevations for a typical OSCAR-13 pass. You will see it is possible to point the antenna toward the position of the satellite at apogee (occurring at phase count 128) and leave it there for two or more hours without repositioning. I have been very successful at manually pointing the antennas during Field Day and other portable operations. This is certainly the simplest and least expensive system for an OSCAR-13 antenna array.

If you already have a rotatable HF beam, you might consider an installation that would give you only azimuth positioning ability. A trick that many mode "A" operators have used is to permanently hard mount your antennas pointed up 25 to 35 degrees in elevation. With the cone of reception that most OSCAR-13 antennas have, you could position the antennas at an inclination of 25 degrees, and with just the azimuth rotation of your HF beam, have good luck in snaring OSCAR-13 signals a certain percentage of the time. Remember though that this is a compromise.

The next step up the ladder toward having a sophisticated system would be to add an elevation positioning system for your OSCAR-13 beams. If you choose to go this step and control the elevation remotely, there are several options available. The least expensive of these is converting a TV rotor much like the U110 Alliance rotor (that many of us use on our smaller 2 meter beams) mounted sideways or horizontally to provide elevation positioning. This rotor is found in the flea-market of many hamfests for under 25 dollars. You could use this elevation rotor with a dedicated, light duty azimuth rotor, or place it above your existing tri-bander and use its azimuth rotor. Past this point there are several commercially available rotors. I have personally used the Kenpro KR500 and have found it to be an excellent elevation rotor. Any of these elevation rotors, in conjunction with a light duty ordinary azimuth rotor, will do fine.

The final step is both elevation and azimuth in one assembly! The Kenpro KR-5400 is an excellent choice. They have designed this system so that one control box does both azimuth and elevation. The Dynetic System's DR10 is a multi-purpose unit that does both azimuth and elevation rotation duty also. Positioning of your antenna array is accomplished with one control box in your station and one compact unit on your tower. Computer programs are available to automatically position these units. Certainly this would be the ultimate antenna positioning system for an OSCAR-13 antenna array. Please note, though, that a computer

controlled rotor system is, in no way, required for successful operation.

The one thing you must not ignore is the sensitivity of the circularly polarized field these antennas produce to metallic objects in that field. The horizontal boom that joins the uplink and downlink antennas needs to be NON-METALLIC. Many of the major suppliers (such as KLM/TEXAS TOWERS/etc) offer a reinforced fiberglass boom of about an inch and a quarter in diameter that works exceptionally well for this purpose. Barring that, I have used wood closet rod, like you would find in your closet or at the local home products store. If you do use wood, be prepared to paint or weather seal it. This boom of course passes through your rotor in a horizontal fashion and elevates both antennas at the same time.

STAY AWAY FROM METAL CROSS BOOMS !!

Along the same line, if you're going to the trouble of using a non-conducting cross boom, it would be senseless to run your coaxial feedline down the antenna and across the elevation boom. The shield of the cable would have the same effect as a metal cross boom. I recommend that your coax exit the antenna from the reflector end with a large slack loop. This is illustrated in the antenna diagram on page 12.

I would suggest spending your money initially on good high quality circularly polarized antennas, a pre-amp, and good coax. Somewhat lower in the budget priority should be the Azimuth-Elevation positioning systems.

3. The Pre-Amplifier - Key to Reception of OSCAR-13

Possibly the most important piece of any OSCAR-13 receiving station is the pre-amplifier. New generation GaAs FET pre-amplifiers are capable of exceptional gain around 20 to 24 dB with almost no added noise (noise figure approximately .5 to 1 dB). To really have an effective OSCAR-13 receiving station YOU MUST HAVE A PRE-AMPLIFIER. I would encourage you to make this the best piece of equipment in your system. Manually point your antennas or buy antennas with slightly less gain before you sacrifice an excellent pre-amplifier for the system. This is the key piece of equipment that separates those who are successful on OSCAR-13 and those who struggle. When I actually got hold of a reasonable pre-amplifier, OSCAR-13 operation became simple!

I would recommend you carefully review the figures of all manufacturers and pick out one that maximizes the gain, minimizes the noise, and still meets your requirements. When I say meets your requirements, one of the things you must consider is how the pre-amplifier you have selected passes 2 meter transmitted RF.

You may sometimes want to transmit relatively high RF power through your 2 meter beams on other modes or for terrestrial work. If you transmit even milliwatts directly into a GaAs FET, you'll blow it up in nanoseconds. To avoid this costly catastrophe, a pre-amplifier with internal switching is desirable. There are several pre-amplifiers on the market that allow a considerable amount of power to be transmitted through them and I suggest you look closely at these. ICOM has recently marketed its unique system of a "dedicated" pre-amplifier. It goes with the 271H and 471H rigs, and is switched on and off from a switch on the front panel of these rigs. These preamps can pass 100 watts, which is all you will ever need! Another preamplifier with internal switching is the Landwehr, distributed by Henry Radio.

Many preamps are available that cannot pass RF but are less expensive. A system of coaxial relays can be configured to switch the preamp in and out of line. This coaxial switch box can be homebrewed or purchased. Only high isolation coaxial relays should be used for this purpose. Advanced Receiver Research is one manufacturer of such a system. The simplest way to use a non-switched preamp is to place it in line unprotected. This certainly works. However, precautions must be taken to remove it from the line before any attempt is made to transmit (or else Boom!).

Another way to use a non-protected preamp is to have it switched in and out of line by a sequencer. A sequence is nothing more than a fancy timer which controls when your transmitter transmits. Your microphone or keyer is hooked to the sequencer, when you key your mike the timing circuits first allow your receive preamp to be switched out of line, then, 50 or so milliseconds later, your amplifier is keyed, and then, 50 milliseconds later than that, the PTT of your transmitter is keyed. Companies such as Advanced Receiver Research sell sequencer and there is a section covering them in ARRL Handbook.

In the optimum configuration, the pre-amplifier needs to be mounted as close to the antennas as possible. Many folks mount theirs on the vertical mast that holds the azimuth rotor. In this configuration, a short drop of coaxial cable from the circularly polarized downlink antenna to the pre-amplifier is needed. The signal is then greatly amplified in the pre-amplifier and then routed to the receiver in the shack. From a signal-to-noise standpoint, it is very important that the signal be amplified before it is routed down a long run of feedline. Ask anybody on the satellite and they'll tell you that this is the best possible receive setup and yields the best possible signal-to-noise ratio.

Under some circumstances you may be able to get away with mounting your preamp in the shack. The price you pay for this is a degradation in signal-to-noise ratio. The coaxial cable between

your antenna and receiver not only attenuates the signal but, because it is not at absolute zero, contributes some thermal noise to the signal.

As a general rule of thumb, if the attenuation of your coaxial cable is less than 1.5 dB, then you may find the receive signal acceptable with the preamp placed in the shack. The advantage of having the preamp inside of the shack is that you don't have to weatherproof it and, if you use a preamp with no switching, it is easy to remove it from the line before transmitting.

I recommend that you compare the signal of the satellite with the preamp placed inside the shack and then at the antenna. After this test, you'll be able to make the decision for yourself.

Below is a partial list of many commercially available preamps. As with antennas, you probably can't go wrong with any of the store-bought models. However, don't count out homebrewing your own. There are several designs that appear in The ARRL Handbook that are very good, and very easy to build.

GaAsFET PreAMP COMPARISON TABLE

MANUFACTURER	MODEL NUMBER	ADVERTISED GAIN(dB)	NOISE FIG.(dB)	ABILITY TO PASS RF	MAST MOUNT.?	PRICE
ICOM (for IC-271H)	AG-25	15	1.2	100 Watts	Yes	\$100.00
Advanced Receiver Research	SP 144VDG	24	.55	25 Watts	NO*	\$110.00
ENCOMM (Tokyo High Power)	HRA-2	18	1.0	150 Watts	Yes	\$120.00
Henry Radio	Landwehr	20	.8	150 Watts 750 Watts (PTT)	Yes	\$180.00

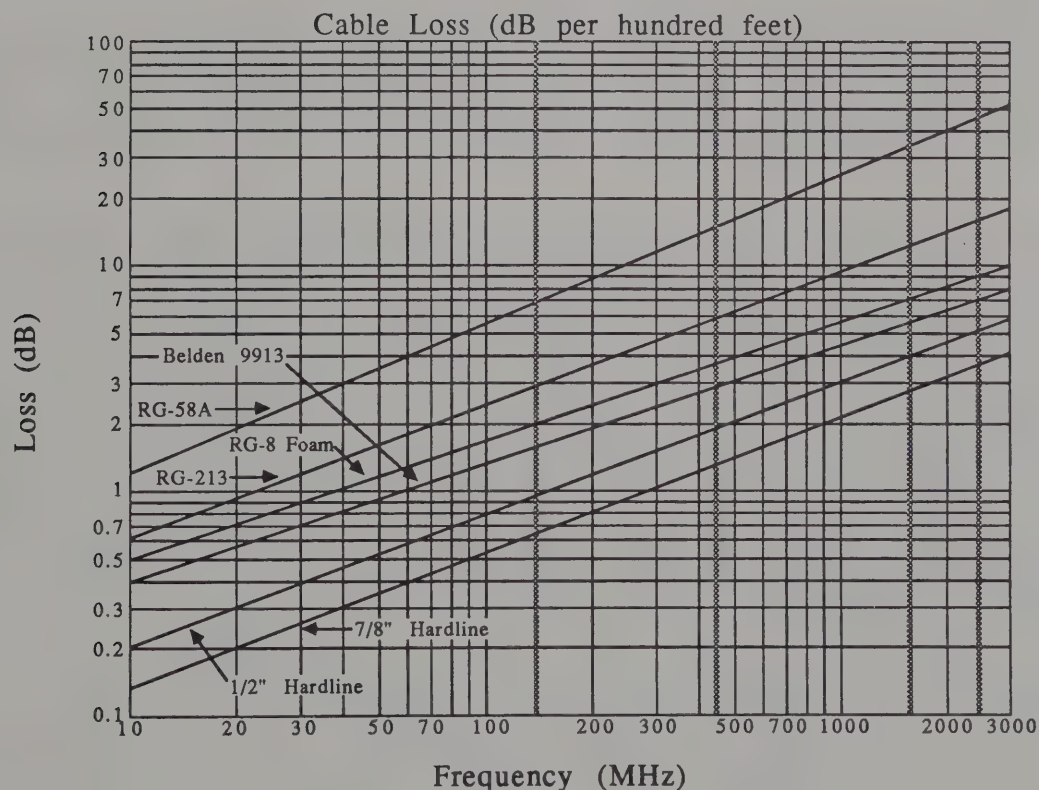
*Must be weatherproofed to be mast mounted.

NOTE: All manufacturers market similar amplifiers, not capable of passing RF, at less cost. Check Advanced Receiver Research, Lunar, Hamtronics, The VHF Shop, etc. for additional models.

In summary, I can't stress enough how important the preamplifier for the downlink signal is in successful OSCAR-13 operation. I would encourage you to spend a lot of time and careful thought before you pick and install this piece of gear. Don't just blindly believe the "numbers" the manufacturers publish, but talk to fellow Hams and get "Field Reports."

4. Feedline - What's That?

Again back to our original precept, if you can't hear them, you can't work them! High quality coaxial cable is important to a successful OSCAR-13 station. Remember, I keep stressing that we have a very small budget of received signal to work with. We gain a lot of amplification in our circularly polarized antenna array. We lose a small amount of that in our coaxial drop down to our pre-amplifier (I would recommend a premium grade RG-8 type coax such as RG-213 or Belden 9913 for this drop due to weight and flexibility considerations). We then gain a bunch in our pre-amp. Now our received signal is ready to go down to our rig. Sometimes this might be quite a few feet away. Here we need to be real careful and make a conscious decision about how much signal we're willing to give away to the loss that is inevitable to any kind of coaxial cable. Carefully review the table found below showing the dB of loss per 100 feet vs. frequency, of commonly used coaxial cable.



I have found that, for the 2 meter downlink signal, hardline is not a necessity, but good quality coax is! In my opinion, Belden 9913 (or equivalent) is an excellent choice for OSCAR-13! It has low attenuation and is priced the same as other premium RG-8 type coaxial cables. It is the best possible cable that you can buy short of hardline. If there is a drawback, it would be that it is

somewhat stiff to work with, and it requires a special N-type center pin in order to use an N-connector (Some folks (including myself) just file down the center conductor of the 9913 so that a standard N-type center pin works). In any case, 9913 is well worth the effort.

While talking about feedlines, I am going to go ahead and cover the transmitter feedline, even though its out of sequence. Again review the feedline table and you'll see that at 435 MHz, the loss in dB gets to be significant! At 435 MHz unless you have a very short run, you may want to consider using hardline. Half inch hardline is sometimes available at hamfests, and of course, available new from any of the amateur mail order dealers. It is not that hard to use and well worth the money invested. It provides a good path to carry the transmitted signal to the uplink antenna with minimum attenuation. As stated before, to some extent, you can make up for feedline losses by increased transmitter or amplifier power. However, if you ever want to use your 435 MHz antennas for receiving other modes, a good low loss feedline is a must. I think if you look at the economics of hardline/high quality coaxial cable vs amplifier cost you will find minimizing the losses in the feedline pays! As a general rule of thumb, try to select a feedline that will, in your installation, keep the attenuation at 435 MHz, not more than 2.5 dB.

I would encourage you to use type-N fittings on your coaxial cable whenever possible. These connectors are truly 50 Ohms and have very low loss and are very reliable. At 435 MHz THROW YOUR PL-259's IN THE TRASH!!! At 2 Meters, PL-259's may be OK, but I don't recommend them. If you end up with a piece of gear with the standard SO239 or PL259, consider changing these to type N connectors. In some cases you can specify the type of connector when ordering the gear. I reference you to the Appendices of this booklet, where you will find some copies of an "Amphenol" and "Kings" connector manual on N-type connectors. This information is very useful in assembling the N-type connectors needed for a successful OSCAR-13 station. The "HANDBOOK" also has some information on this.

You should give close attention to weather-proofing your connectors and feedline. Moisture intrusion into coax and associated connectors will quickly degrade the performance of your carefully planned system. A good idea is to use heat-shrink tubing over all fittings and spray all other points of possible corrosion / water-intrusion with "CRC Soft SEAL", COAX-SEAL, or other sealer. Also, the type-N connectors I suggested above, by design, greatly reduces the possibility of water intrusion.

5. The Receiver

We should now have, in the hamshack, a signal that has undergone as much gain and as little attenuation as possible. We are now ready to turn this signal into audio. The type of receiver that the majority of the OSCAR-13 operators use is an all mode 2 meter base rig. The smaller 2 meter all mode mobile units are certainly acceptable for satellite operation also. When we say "all mode" this implies that the rig is capable of single sideband and CW operation.

In choosing a receiver for OSCAR-13 try to listen to several of them and judge for yourself how they perform. Since single sideband and CW are used, the receiver tuning should be very fine. A tuning rate of not more than 100 Hz per increment is mandatory, and 10 Hz per step is nice. Also, your receiver should have some kind of noise blanker. Living in the suburbs like I do, a noise blanker is mandatory.

On the next page is a list of every commercially available all mode 2 Meter rig that I could find manufactured in the past 10 years. I'm sure that there are a few that I left out. Some of the older rigs that I've mentioned here can be found at hamfests for a considerable savings over what a new one would cost.

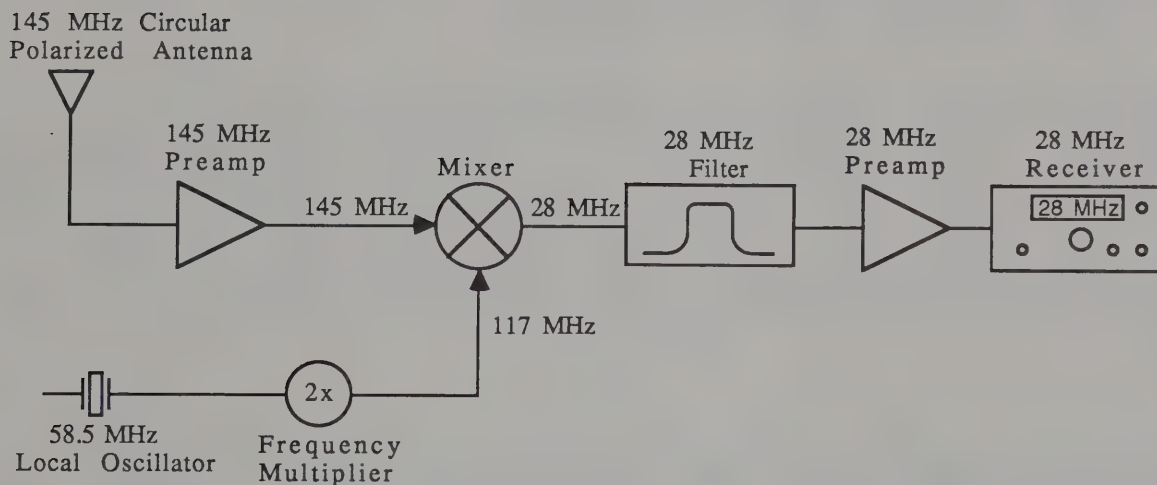
There are a few other rigs that should be called to your attention. One of these is the Yaesu FT-726R (or the newer FT-736R). I've had QSO's with people using this rig all over the world. It is capable of all mode operation on bands between 15 Meters and 1.2 GHz. Depending on the modules selected, full duplex operation is possible on the major satellite bands. Another is the TEN TEC 2510. This is a dedicated mode B station in one package. It consists of a 2 Meter to 28 MHz receive converter and a 435 MHz transmitter. The February 1985 edition of "CQ" (p. 44) had an excellent write up on the 2510.

And, as before, there is an alternative. There are a host of transverters and converters available for OSCAR-13 that take the "downlink" and convert it to a 28 MHz signal so you can use your existing HF transceiver.

ALL MODE 2-METER TRANSCEIVERS

MANUFACTURER	MODEL NUMBER	OUTPUT POWER
ICOM	IC-211	10 WATTS
ICOM	IC-245	10 WATTS
ICOM	IC-251A	10 WATTS
ICOM	IC-271A	25 WATTS
ICOM	IC-271H	100 WATTS
ICOM	IC-275A	25 WATTS
ICOM	IC-275H	100 WATTS
ICOM	IC-290A	10 WATTS
ICOM	IC-290H	25 WATTS
KENWOOD	TS-700	10 WATTS
KENWOOD	TR-751A	25 WATTS
KENWOOD	TS-711A	25 WATTS
KENWOOD	TR-9000	10 WATTS
KENWOOD	TR-9130	25 WATTS
KENWOOD	TS-790A	45 WATTS
YAESU	FT-290R	2.5 WATTS
YAESU	FT-290R MK2	10 WATTS
YAESU	FT-480R	10 WATTS
YAESU	FT-726R	10 WATTS
YAESU	FT-736R	25 WATTS

The concept of a receive converter is really quite simple. The 145 MHz RF is delivered to the receive converter from the preamp. The receive converter then amplifies and filters the signal. The RF is then mixed with a 117 MHz local oscillator to produce 28 and 262 MHz ($145-117$ & $145+117$ MHz). Of course we only want the 28 MHz energy, so the higher order mixing product is filtered out leaving only the desired frequency. The 28 MHz RF is then delivered to your HF transceiver and turned into audio in the usual manner. Receive converters are the simplest and least expensive way to receive OSCAR-13. A block diagram of a receive converter system is shown below.



145 MHz To 28 MHz Receive Converter

Places to find receive converters and transverters include:
 The PX Shack, Transverters Unlimited, Advanced Receiver Research,
 Hamtronics, Down East Microwave, Spectrum International.

Whichever receiver you choose, I urge you to put the majority of your effort in designing and assembling a good receive station before you try to uplink.

6. The Transmitter

The last piece of equipment that will make your OSCAR-13 station complete is the transmitter. After your receive station is complete and you can repeatably hear the satellite, you'll want to select a transmitter that will allow the rest of the world to hear you. However, as with any piece of satellite equipment, there are a few things to look for in selecting the best transmitting system for you.

The transmitter that the majority of the folks use on OSCAR-13 is the all mode 430 MHz transceiver. When we say "all mode" this means that you need to be able to transmit CW and SSB. The major manufacturers, such as Kenwood, Icom, Yaesu etc., make a variety of rigs that are suitable for satellite work and are readily available from your favorite radio store.

The major feature that should be included on any OSCAR-13 transmitter is the ability to vary the output power. As will be discussed in the Operations section, the amount of power required to uplink to the satellite will change depending on many factors. In my past experience on the satellite, I have used as little as five Watts and as many as 80 or 90 Watts to achieve a successful uplink. The typical power, though, is around 30 Watts. Of course this figure will change depending on your feedline and antenna gain.

The average commercially made transceiver can transmit 10 Watts of 435 MHz energy. There are a few that can deliver 25 Watts, and the Icom "H" series of radios (471H, 475H) are capable of 75 Watts. Unless you purchase one of the high power units, some sort of amplifier will probably be required.

Another feature to look for in a transmitter is the ability to transmit while changing frequency. I have run into some older rigs that could not transmit while QSY'ing and it made operating very difficult.

On the next page is a list of every commercially manufactured 430 MHz rig that I could find made in the past 10 years.

<u>ALL MODE 430 MHz TRANSCEIVERS</u>		
<u>MANUFACTURER</u>	<u>MODEL</u>	<u>POWER OUTPUT</u>
ICOM	IC-451A	10 WATTS
ICOM	IC-471A	25
ICOM	IC-471H	75
ICOM	IC-475A	25
ICOM	IC-475H	75
ICOM	IC-490	10

KENWOOD	TR-9500	10
KENWOOD	TS-851A	25
KENWOOD	TS-811A	25
KENWOOD	TS-790A	40

YAESU	FT-780R	25
YAESU	FT-790R	1.0
YAESU	FT-790RMK2	25
YAESU	FT-726R	10
YAESU	FT-736R	25

If you can't justify the price of an all mode 430 MHz rig you may want to consider a transverter or perhaps just a transmit converter. Transmit converters work on exactly the same principle as receive converters, only in reverse. A small amount of 28 MHz energy from your HF transceiver is mixed with a 407 MHz local oscillator to produce 435 Mhz and 379 MHz (407+28 & 407-28 MHz). Of course we only want the 435 MHz signal so the 379 MHz is filtered out. The 435 MHz signal is then amplified many times until the desired output power level is reached.

I personally know 8 or 10 people in my local area that are active on OSCAR-13. I estimate that half of them use a 435 MHz transverter on the satellites. Transmit converters are the easiest and least expensive way to uplink to OSCAR-13.

7. EQUIPMENT SUMMARY

You should now have a basic understanding of all of the building blocks of a typical mode B station. The concepts that you've learned here can be directly used to configure your station for any of the other modes such as Mode J or L.

Just a quick review of a mode "B" station :

- * Use good quality circularly polarized antennas.
- * They don't have to be up very high.
- * Use the best preamp you can find.
- * Use very low loss feedline.
- * Use N-type connectors
- * Use a good 2 Meter SSB receiver or a receive converter.
- * Typically 10 to 50 Watts of 435 MHz transmit power required.

VI. SATELLITE TRACKING

OR - IF YOU CAN'T FIND'EM, YOU CAN'T WORK'EM

Before you can communicate through the satellite, you've got to know where it is. Since the satellite is in an orbit that is non-geosynchronous, its position moves around in the sky. When the satellite is in view, you need to know where to point your antennas and if the satellite is not in view, its nice to know when it next will be.

Finding OSCAR-13 can sometimes be a bit tricky unless you have the right equipment. The vast majority track the satellites using a computer. AMSAT has software for almost every computer you can imagine, from the Sinclair/Timex to the IBM PC. I have personally used tracking programs written for the Apple, Commodore 64, Macintosh, and the IBM PC and found that all are menu driven, user friendly, and very accurate.

The function of all of the satellite tracking programs is basically the same. They give you a predicted satellite position at a given time and tell you where to point your antennas based on your longitude and latitude. All programs give you this data in numerical or tabular form, and many will also show you where the satellite is graphically on a world map.

Most versions have two important functions in common that are very useful: The "Scheduling" mode and the "Tracking" mode. In the scheduling mode the computer will tell you when a given satellite will first appear on your horizon (Acquisition of Signal) and then when it will go below your horizon (Loss of Signal). This is particularly useful in determining when you can work a future pass of the satellite. The time that you tell the computer to begin calculating does not have to be "today". You can tell the computer to give you the passes of tomorrow, next week, or even next year; Its just "numbers" to the computer.

An example partial printout of the scheduling mode from the IBM PC. appears below.

SCHEDULE FOR SATELLITE OSCAR-13

DATE	AOS	MAX	LOS	EPOCH	DX/EL	AZ	ORBIT
07DEC88	180343	221352	035549	08DEC88	17213	273	370
08DEC88	112618	112618	141600	08DEC88	17985 *	66	371
08DEC88	164332	210714	024658	09DEC88	16061	265	372
09DEC88	114100	114100	124547	09DEC88	17570 *	52	373
09DEC88	152917	200037	013723	10DEC88	14712	254	374

- Date - UTC date. Remember, date change is at 6:00 PM CST.
- AOS - Acquisition Of Signal (UTC). Time that the satellite appears above your horizon. Format is HHMMSS.
- MAX - Time (UTC) of maximum elevation angle. Also, time for reported azimuth.
- LOS - Loss Of Signal (UTC). Time that the satellite goes below your horizon. Format is HHMMSS.
- EPOCH - Date (UTC) at the end of the pass.
- DX/EL - Peak elevation angle that occurs during this pass on circular orbit satellites, or maximum communications range in km on elliptical satellites.
- AZ - Azimuth angle at peak elevation.
Remember: 0 Deg. = North, 90 Deg. = East
180 Deg. = South, 270 Deg.= West
- Orbit - Number of revolutions around the Earth that the satellite has made since launch.

Once you have determined which pass of the satellite that you would like to work, you can then switch to the tracking mode. The "tracking mode" is used to give you a numerical readout of where the satellite is at a particular time in terms of azimuth

and elevation. In other words, when you want to know where to point your antennas now, this is the routine to use. The way that I use this mode on OSCAR-13 is to get a printout of an entire pass with a new azimuth and elevation reading for every 15 to 20 minutes. In many cases, especially at apogee, the satellite moves less than 2 or 3 degrees and no antenna repositioning is required. After an hour or so, when the satellite has moved more than 10 degrees, I'll "bump" the rotors and be set for another hour.

An example of a partial printout of the tracking mode on the Commodore C-64 is given below. The Commodore C-64 version of the tracking mode lists a new line of data every time the satellite moves more than 9 degrees in azimuth or elevation. (This number can be changed.)

Date	UTC	AZ	EL	RANGE	LNG/LAT	PHASE
23JAN89	122130	194	0	11932	114/-38	25
23JAN89	123652	193	9	21218	111/-31	30
23JAN89	125215	193	16	23082	110/-26	36
23JAN89	131522	196	25	25737	111/-19	45
23JAN89	134813	202	33	29106	114/-12	57
23JAN89	143142	214	40	32773	120/ -4	73
23JAN89	151511	228	42	35550	127 2	89
23JAN89	155840	242	41	37462	134/ 8	106
23JAN89	164209	252	39	38511	141/ 13	122
23JAN89	172538	262	35	38671	149/ 19	138
23JAN89	180907	275	31	37881	155/ 23	154
.	.	.	.	.	.	.
.	.	.	.	.	.	.
.	.	.	.	.	.	.
23JAN89	223404	123	0	6326	60/ 4	253

DATE.....Date in UTC. Remember date changes at 6:00 P.M. CST.

UTC.....Time UTC. Format is HHMMSS

AZ..... Azimuth angle of the satellite at the time given.

Remember: 0 Deg. = North, 90 Deg. = East
180 Deg. = South, 270 Deg.= West

EL.....Elevation angle of the satellite at the time given.

Remember: 0 Deg. = On the local horizon.
90 Deg. = Directly overhead.

RANGEDistance from the satellite to you in Kilometers.

LAT/LON...Latitude and longitude of the sub-satellite point.

PHASE.....Phase count of the orbit of the satellite (0 - 256).
Modes of OSCAR-13 change depending on the phase #.

The essential information that you really need to work the satellite is the time, azimuth, and elevation. The rest is interesting to know for other reasons. For example, on OSCAR-13, the mode (B, J/L, and S) changes depending on the phase count.

With the correct external hardware, some computers can be made to automatically point your antennas at the satellite. When the bird moves more than a preset number of degrees the computer will command to rotors to reposition the antennas. You can work an entire pass of the satellite and never touch your rotors. This can be particularly handy when working a "low earth", quick moving satellite such as RS 10/11 or OSCAR-12. I know that the AMSAT software for the IMB PC, Apple, Macintosh, and Commodore C-64 are capable of auto-tracking. It should be emphasized, though, that the ability to do this is not, in any way, a necessity to work OSCAR-13.

KEPLERIAN ELEMENTS

The computer calculates where the satellite is by knowing where it was. Or, more precisely, by knowing where the satellite was (say a week ago) and by knowing the characteristics of the orbit, the computer can predict where the satellite is now. As a simple example, if a train is traveling along a straight track at 50 miles per hour, I can predict that the train will be 100 miles down the track in two hours and 1000 miles down the track in 20 hours.

A "snap shot" in time of the orbital parameters of the satellite is placed in a file of the computer program. These orbital parameters are called Keplerian elements named after Johannes Kepler the German astronomer who first mathematically described the motion of the planets. These elements are measured by NASA and are free to anyone. AMSAT routinely distributes updated element sets for all amateur satellites, weather satellites, and certain other spacecraft such as the Soviet space station MIR. They can be found on the AMSAT BBS, some packet BBS stations, HF nets, and local VHF nets.

Please note that in the Appendices there is a net schedule for AMSAT's HF and VHF information nets. These are valuable sources of information on OSCAR-13 and frequently give the orbital elements necessary for the computer programs. Make a note to listen to the AMSAT nets on a weekly basis so you can be updated on this information.

Though new Keplerian elements are made available on the average of once a week, I have found that a three month old element set gives surprisingly accurate results on OSCAR-13. For satellites in a low earth orbit, such as RS-10/11 and OSCAR-12, the element set should be updated about once per month, and on manned

spacecraft that actively maneuver, such as MIR, updates of once per week are sometimes necessary.

POINTING ANGLE

As was previously mentioned, elliptical orbit satellites such as OSCAR-13 are "spin stabilized" such that its antennas are pointed at the center of the Earth when the satellite is at apogee. During times of less than "ideal" illumination of the solar panels by the Sun, the attitude of the satellite can be changed to compromise between best solar illumination and communications capability. When this happens, the satellite's antennas becomes "off pointed" or "squinted" away from their ideal attitude at apogee. This is important because best communications usually occurs when the satellites antennas are pointed directly at the Earth, or more specifically, your QTH. The measure of the angle between you, the satellite, and where the satellites antennas are pointing at any given time is known as the "off pointing angle (PA)". A PA of zero degrees means that the satellites antennas are pointed directly at your QTH at that time. A PA of 90 degrees means that the satellites antennas are perpendicular to the line of sight between your QTH and the satellite position.

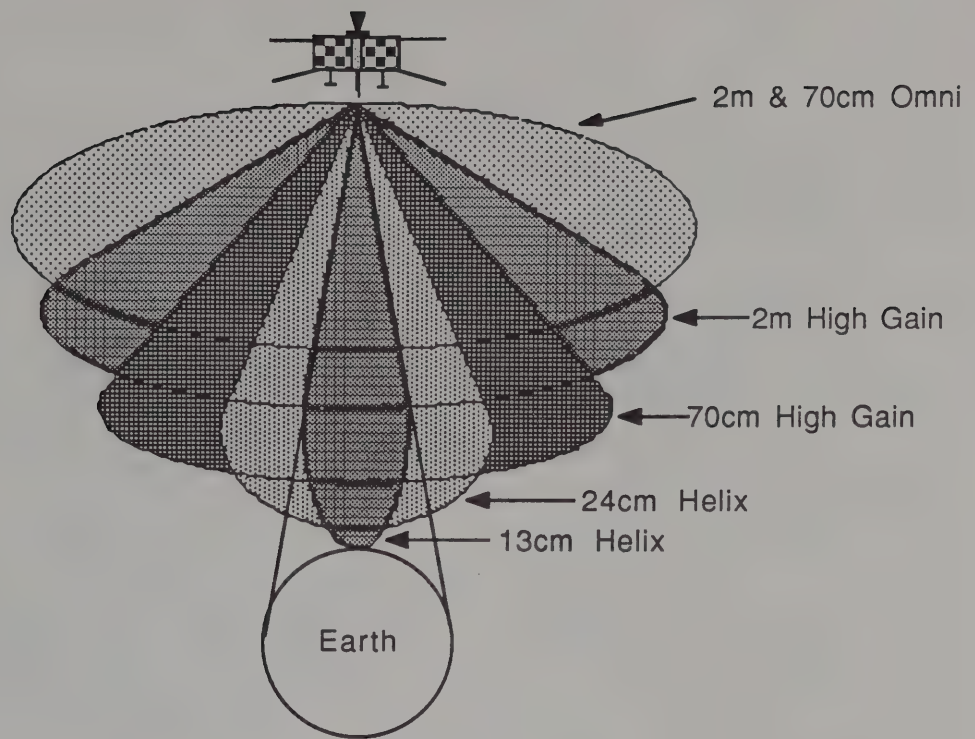
With a knowledge of the PA and a knowledge of the satellite antenna beamwidths it is possible to gain an understanding of the variations in quality of the satellite signal. Naturally if you are in the main beam of the satellites' antennas it will sound better than if you are not. The PA information is utilized by the satellite control stations in planning the mode schedule. For example, the schedule for Mode L occurs when the PA is minimum due to the narrow beamwidth of the mode L helix antenna. Since the Mode B antennas have a wider beamwidth, Mode B is scheduled when the PA is not so critical.

Some computer programs, such as AMSAT's Quiktrak for the IBM computers, compute the PA for each step of the prediction. When properly understood, this feature can make your life on the satellite much more enjoyable. You will quit wasting your time operating when the signals are weak and spin modulation heavy due to "off pointing"

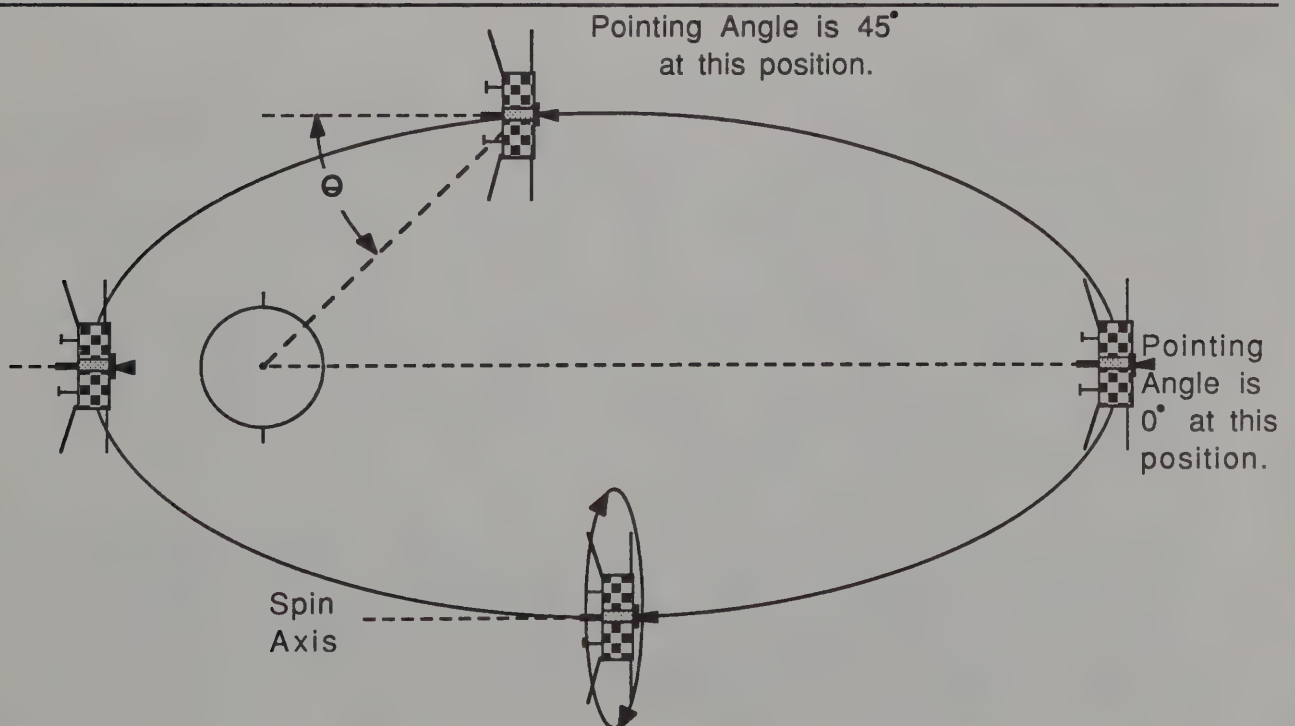
MEAN ANOMALY

Mean Anomaly is another parameter that most computer tracking programs keep track of. It is a measure of where a satellite is in its orbit. An orbit consists of 0 - 256 Mean Anomaly (MA) degrees, with 0 MA degrees describing perigee, 128 Ma Degrees describing apogee, and again back to 256 (or zero).

The reason that MA is important is that the satellite controllers will change the mode of the satellites transponders depending on



Beamwidth of OSCAR-13's Antennas



**Pointing Angle of OSCAR-13's Antennas
Depends on it's Orbital Position**

where the satellite is in its orbit. Knowing the Pointing angle of the satellite's antennas, and knowing the beamwidths of the satellite's antennas, the satellite command stations will tell the satellite to switch modes as a function of the MA.

SATELLITE TRACKING SUMMARY

Stop by the AMSAT booth at your next major hamfest and they will probably be demonstrating satellite tracking software for many of the major computers. Or, if you wish, write to AMSAT HQ (with s.a.s.e) and they will be glad to mail you the latest software availability sheet.

VII. OPERATING ON OSCAR-13

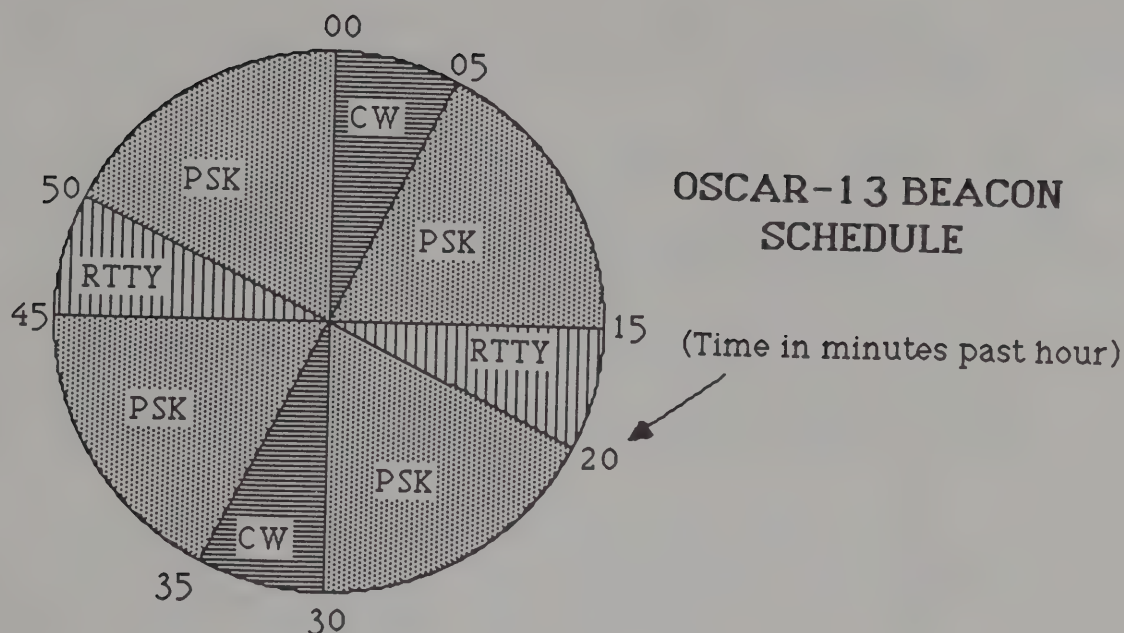
If you're like many satellite enthusiasts, the challenge of assembling your station is half of the fun. But now, on to the other half of the fun. Its now time to learn what it takes to have a QSO through OSCAR-13. Like assembling your station, however, there is a systematic approach. You don't just pick up the microphone and start talking. You must first learn when and where to listen and how and where to transmit. As before, fear not, we'll take it a step at a time.

1. RECEIVING

What do you listen for on OSCAR-13? Well the best place to listen is to tune to 145.812 MHz on upper side band and listen for the OSCAR-13 beacon. OSCAR-13 has an on-board beacon that transmits continuously on 145.812 MHz except when the satellite is in mode J/L. This beacon makes a "growling sound" (this is the PSK- Phase Shift Keying mode that the beacon is in most of the time) unless it is sending a CW or RTTY message (more on the beacon's format in a minute). Remember in mode B the downlink signal is on two meters at around 145 MHz and on the uplink at 435 MHz. You'll know you have your antenna set at the right angles when you hear this beacon. You can check for correct antenna position by "tweaking" your azimuth and elevation for maximum beacon signal strength.

Once you've carefully listened to the beacon, you'll find that it gives you much valuable information. In addition to the PSK telemetry you'll find that it regularly transmits 10 WPM CW and common RTTY. (Please note that the beacon transmits 50 baud RTTY and not 45 baud, although, most 45 baud machines will copy it. Also use USB to copy the RTTY beacon.)

A graph of the beacons operating schedule appears on the next page. At 0 and 30 minutes past the hour the beacon transmits 10 WPM CW for about five minutes. At 15 and 45 minutes past the hour it then switches to RTTY for five minuets. All other times are used to transmit the PSK engineering data and telemetry.



The CW bulletins on the beacon have information on things like which mode the satellite will be in at which phase counts, keplerian data, and other general announcements. The RTTY bulletins contain all of the CW information plus satellite status telemetry.

Perhaps the most important information contained on the beacon is not what is transmitted, but how strongly it is received. The beacon on OSCAR-13 is transmitting at a constant output power of 1 Watt. This is very important because everything you transmit or receive on the satellite is referenced to the beacons' received strength. As you know, the S meter readings vary from receiver to receiver, so any change that you make to your receive station or any change that is made in the position of the satellite will show up as a change of "X" S-units on your receiver. Also, and most importantly, since OSCAR-13 has linear transponders, the stronger you transmit, the stronger your downlink will be. The custom is to use only the transmit power required to make your downlink signal strength equal to the beacon. If this format is followed by all users, this "calibrates" all stations, making up for receive capability differences from station to station. This is a very important thing to understand when working OSCAR-13. If your signal is louder than the beacon then you are using more than your share of the limited spacecraft power. If your downlink

is equal to the beacon, and you have difficulty understanding yourself or others, you need to work on improving your receive station. (This will be covered in much more detail in the Transmit section.)

Though there is no official bandplan for OSCAR-13, the satellite operating community seems to have adopted the old OSCAR-10 plan. The OSCAR-10 plan had the 2-Meter downlink passband (literally the band of frequencies passed by the satellite's transponder) split into three equal sections. The upper third of the band is used for SSB phone only. The middle third can be used for mixed SSB / CW and the lower third is used for CW & RTTY only. If you want to listen to phone QSOs, I recommend that you tune to about 145.900 and up. You'll often hear two or three CW QSOs going on around 145.870 and, for some reason, many DX stations seem to prefer the upper portion of the phone band around 145.945.

As when you were first starting out in HF, I recommend that you listen to a few QSOs first. They are not too much different than HF except that you'll hear people calling "CQ Satellite", or "CQ OSCAR-13". The other major difference is that all QSOs are full duplex, that is, the person talking can hear himself and the person listening can interrupt at any time (much like on the telephone).

This takes some getting used to, but when you do, you'll wish that all of your HF and VHF QSOs were full duplex also.

2. TRANSMITTING

As discussed before, the transponder on board OSCAR-13 operates on the principal of a "translation frequency." In simple terms, this means the satellite translates or converts any received signal to a different frequency for transmission back to Earth. For OSCAR-13, the translation frequency is 581.398 MHz. That is, the frequency of the signal beamed back to Earth is equal to 581.398 minus the frequency of the signal received by the bird from Earth. If you transmit up at 435.508 MHz, for example, then the Bird will re-transmit it at $(581.398 - 435.508 =) 145.890$ Mhz. In other words, if you transmit up at 435.508 Mhz, you should expect to receive your own downlink on 145.890 MHz. A table in the Appendix shows these relationships so no calculations on your part are necessary.

One of the things that should be noted is that the OSCAR-13 transponders "inverts" signals as it retransmits them. If you uplink on LSB you will downlink on USB. This is the established convention on OSCAR-13; uplink on lower side band, and downlink on upper side band. Make sure when you are trying a single side band QSO that you adhere to this convention. RTTY in most cases is done by AFSK also using this convention, uplink on lower, downlink on upper. CW is rather obvious, up on CW, and down on

CW. Follow this convention and you will have no trouble receiving your signal.

No more would have to be said about the frequency of the signal received from the Bird were it not for the "Doppler Shift". We have all stood by a railroad track and heard the pitch of the train whistle change as the train approaches and then passes us. That change in pitch was very real even though the frequency of sound coming out of the whistle remained constant. We heard a change in pitch because the source of the sound was moving at a significant fraction of the speed of sound. We received and heard a slightly higher frequency (or pitch) as the train came toward us and a slightly lower frequency as the train moved away from us. As with sound waves, Doppler shift also applies to radio waves. OSCAR-13, in orbit around the earth, moves at a measurable fraction of the speed of light, so therefor we encounter a perceived frequency shift of +/- two or three kilohertz in our receivers. The frequency is higher as the satellite moves towards us and lower as the satellite moves away from us. This doppler shift causes us to make a minor "correction" to the frequency at which we should expect to tune our receiver, however, due to OSCAR-13s' long orbit, the rate of change in the doppler is not very quick.

Let's say you want to talk on single side band. The first step is to pick out the frequency you wish to downlink on. For this example let's assume you find a clear frequency at 145.940 MHz and wish to call CQ there. Next, look on the Mode B frequency guide chart and see that you should set your uplink station to 435.458 MHz, LSB. Now get ready to transmit. The correct way to initially locate (receive) yourself is to send a few CW dots or, on SSB, say "hello, hello" on 435.458, and simultaneously carefully listen for your signal around 145.940. Because of the Doppler Shift it will be necessary to tune your receiver, slightly back and forth around 145.940, until you begin to hear those dots come back down to you. Tune your receiver, not your transmitter, for the very best possible reception. DO NOT SWISH YOUR TRANSMITTER'S VFO BACK AND FORTH WHILE TRYING TO FIND THE DOWNLINK. Once this is done you have established the "translation frequency" that accounts for the Doppler Shift at this particular point in the orbit. Make a note on a piece of scratch paper that the downlink during this portion of the orbit is, for example, +1.7 KHz or -1.2 KHz different than predicted. Then, when you QSY to make a QSO, you'll know, to within 100 Hz where to place your transmitter. (Be sure to I.D. at this point!)

Establishing a QSO on the satellite is done much the way that it is done on HF. You may want to call CQ by saying "CQ satellite" or, "CQ OSCAR-13", or just plain "CQ" if you like. To answer someone calling CQ, make note of the receive frequency and turn your transmitter to the correct uplink frequency as discussed previously. After establishing a QSO on a given downlink

frequency, we only make slight adjustments to our transmitter to accommodate for the Doppler shift. DO NOT TUNE THE RECEIVER WHILE IN QSO!

This will prevent you from inadvertently shifting your downlink signal into another QSO.

The concept, that I hope is becoming obvious to you, is that we are participating in a "full duplex operation". That is, you can hear yourself on the downlink at the same time you are transmitting on the uplink. Even though RST signal reports are typically given, there is really no need. You can hear yourself through the satellite on the exact same downlink that everybody else hears. With this in mind, it should be obvious that there is no excuse for excessive QRM and no excuse for drifting into another QSO.

While we're talking about transmitting lets discuss uplink power. The typical 430 MHz transmitter puts out around 10 to 25 Watts of power. Very few of them put out significantly more than that. You'll find that it takes 10 watts or more to uplink effectively. What you want to do is begin your OSCAR-13 session by listening to the beacon, noting carefully what kind of S meter readings you get from the downlink signal. S3, S5, S6 etc. Next, pick a frequency to call CQ on, as we've just described to ensure that your signal comes out in that part of the pass band you desire then start transmitting. Since this is duplex, monitor your downlink signal strength carefully, and adjust your uplink power so your downlink signal strength is slightly less than that you copied on the beacon. If we transmit up a lot of power, (which can certainly be done with a large linear amplifier and the high gain antennas available) we can activate the automatic level control circuitry in OSCAR-13, which will then cut back on the power available for everyone else on the satellite. It will make everyone else who doesn't have 14 gigawatts of uplink power unable to use the bird. This is certainly not fair or in anyway in the spirit of amateur radio. I encourage you to uplink with 10 watts first, listen and increase your power only if you can't hear yourself and then only until your downlink signal is about equal to the received signal strength that you copied on the 145.810 MHz beacon. This is good practice on OSCAR-13 and something that benefits everyone. If you find an amplifier is needed, there are several on the market that do an excellent job of amplifying uplink signals. I found that with an excellent receiving station as previously discussed, good operating technique, and good satellite orientation, I have had many QSOs with 10 watts of uplink power.

Typically, OSCAR-13 operators operate with headphones to prevent their rig's speaker (the downlink signal) from establishing a feedback loop with the uplink signal. With the satellite being 30,000 km away, this feedback loop can be horrendous when it gets going! Please be careful not to let it get started! If you are

uplinking on sideband, you'll find that it's very difficult to listen to yourself coming back down, a quarter of a second or so later. This time delay is due to the time it takes the RF to go this significant distance and back. It will tend to make you slur your speech. Don't get upset, whenever one of the experienced OSCAR-13 operators hears this, he knows he's got a newcomer to the band and will be very courteous about telling you, "Yes you are on frequency stop here, don't tune anymore," and you'll finally get comfortable while listening to yourself as you talk.

I find that sometimes, after I've established contact, its easy to turn the downlink audio low enough so that I know that my voice is there, but not loud enough to be disturbing. I'll then periodically turn the audio back up to make sure that the frequency hasn't drifted significantly. I recommend this technique to you if you have trouble slowing your speech down or slurring it while in QSO.

Since we talked about how to transmit on OSCAR-13, it is now appropriate to discuss what not to transmit. Even though OSCAR-13 has linear transponders, they are not intended for FM operation. FM is a continuous duty mode that is very wasteful in terms of bandwidth, and amount of information carried per Watt. Someday when the mode S transponders get to be more mature we may well have FM channels, but not now. So, please limit yourself to single side band, CW, RTTY, Packet, and similar low duty cycle modes. Everybody who uses OSCAR-13 will appreciate it.

3. SUMMARY

When you want to make a satellite QSO, the first thing you should do is tune to the beacon on 145.812 MHz. The primary information that you are looking for is the beacon's signal strength. If you have time copy the CW or RTTY bulletin.

Next, what I like to do is tune through the downlink passband and "get a feel" for what's going on. It's nice to know how heavily loaded the transponder is.

Before you uplink, determine the doppler shift at that particular time in the orbit. Some computer tracking programs will tell you this, or you can determine it by making a note of how your downlink frequency differs from the predicted frequency.

When you do engage in a QSO, use only enough uplink power to make your downlink signal strength equal to (or slightly less than) the beacon. Also, once you've established a downlink frequency, if you find that the signal has drifted, make corrections with your transmitter only.

VIII. OTHER MODES

Well, hopefully you should have a pretty good understanding of the ins and outs of a Mode B station. As the ARMY slogan says, "It's a great place to start". There are, as you know, other modes available to you on AMSAT OSCAR-13. Setting up a station for one of the other modes is done exactly the same way as for Mode B. Simply put, you need to know on what band to receive a fairly weak downlink signal, and, you need to know on what band to uplink with enough power to make your downlink equal in strength to the beacon on that mode. The following is a brief description of the other modes on OSCAR-13.

The Modes on Oscar-13 ,besides B, are Mode J, Mode L, and Mode S. The majority of the time, when Mode L is on, so is Mode J.

Mode J

As can be seen on the frequency guide in the appendix, Mode J, in a sense, is the opposite to Mode B. On Mode J you uplink on 2 Meters and you downlink on 435 MHz. This mode is popular in Japan because the 2 Meter band is extremely crowded and downlinking on 2 Meters (as in Mode B) is difficult.

If, on your Mode B station, you are using all mode 144 and 435 MHz radios, then with the addition of a GaAs FET preamp for 435 MHz, you are in business. The same antennas used for Mode B can be used in Mode J.

For some people, getting on Mode J is easier than Mode B. If you already have an all mode 2 Meter rig (from your Mode A station), all that you need is a preamp and a 435 MHz to 28 MHz receive converter. The 435 MHz transmitter can be added later as finances allow.

One of the common problems associated with mode J is that the third harmonic of the 145 MHz transmit signal falls in the pass band of the 435 MHz receiver. The severity of this problem varies from station to station (I don't have any problem), however, with good quality coaxial cable, good N-type connectors, an adequate separation between the two coaxes and antennas, and a clean amplifier on 2 Meters, the problem should be minimal. Under extreme circumstances, some sort of harmonic filter or low-pass filter may have to be installed on your transmit line.

Mode L

I believe that Mode L is the mode of the future. As you can see on the frequency sheet in the appendix, there is over 350 KHz of passband. The uplink is on 1269 MHz and the downlink is on 435

MHz. 435 MHz is nice to downlink on because there is less man made noise and less sky noise to compete with the signal.

Though there are a few rigs on the market that will transmit on 1269 MHz, the vast majority use some sort of transmit converter. With a four or five foot dish and 10 to 20 Watts adequate downlink signals can be produced under most circumstances.

If you thought that the signal attenuation in coaxial cable is bad on the 435 MHz band, just look at 1269 MHz. Feedline runs at this frequency must be kept extremely short. Hardline or Heliax really starts to pay for itself here. As with Mode B, you can make up for feedline loss if you have the extra transmit power to spare, however, power amplification at this frequency is expensive.

Mode J/L

As previously stated, most of the time Mode J and L are on at the same time. The downlink on Modes J falls in the high end of the Mode L passband. What this means is that, in the 40 KHz Mode J window, a station on Mode L can talk to a station using Mode J. I have heard this done on several occasions.

Mode S

At this time, Mode S is still very young. It is hoped, one day, that this mode can be utilized for one or two strong FM stations for AMSAT announcements, cross linking, and other public service occasions. The uplink is on 435 MHz and the downlink is on 2400 MHz.

IX. IT'S UP TO YOU NOW!

I hope you find the preceding descriptions helpful. Supplied with this booklet is a complete listing of all the AREA COORDINATORS in your area. The Area Coordinator close to you is the best person for you to get to know to help you get on the Bird. So by all means give one of us a call if you need help. That's what Area Coordinators are for!

You can find me listed under the area coordinators of the fifth call area. I am available at virtually any time to try to answer your questions as is most any AMSAT member.

Let me emphasize one last time, put your initial efforts and cash outlay into a good receiving system, use only the uplink power necessary for good downlinking, and don't be afraid to homebrew some of your equipment. There is a lot of useful info in the Appendices, please review them carefully. Good Luck and I hope to hear you on the bird.

73's
Keith Berglund WB5ZDP
AMSAT Area Coordinator
March 1989

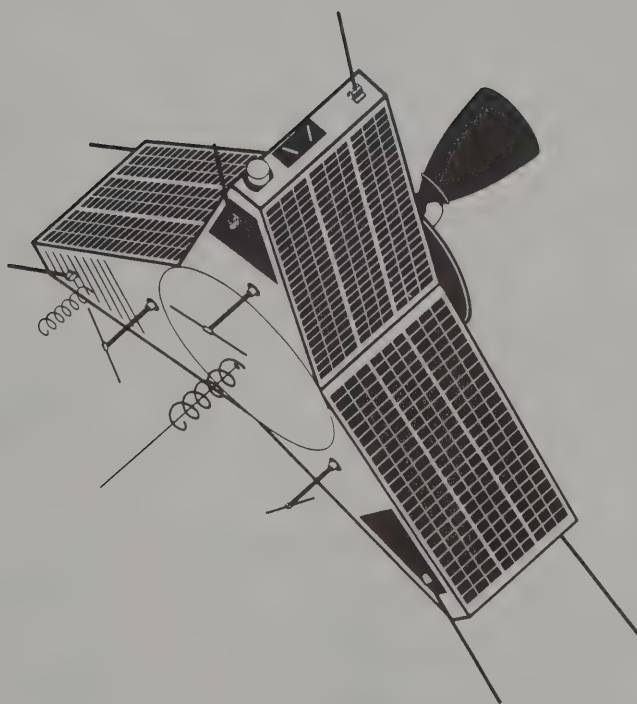
P.S. I would like all your comments, pro and con, on this booklet as I intend to update it if you think it's worthwhile. Please write me at:

Keith A. Berglund WB5ZDP
2936 Elsinor Drive
Fort Worth, Texas 76116

Also, to be fair to AMSAT, the comments and opinions I offered in this booklet are drawn only from my experience. Please do not take them as an endorsement or recommendation of any kind by AMSAT. AMSAT obviously cannot and does not want to favor anybody's equipment and I am sure would probably not want me to come across as representing their opinions. I have only discussed a limited sample of available equipment. I do not doubt that there is a considerable amount of gear out there that is better than that which I have commented on. So please do not get upset with AMSAT (or me for that matter), if I have not mentioned something you like. Instead, write me and tell me about your concerns. I can then incorporate them in the next revision. Also, my opinions are based on only my limited experience and of course this is far from a scientific or accurate method evaluating something.

I have received a lot of help with this booklet and would like to thank the following AMSAT Members for their significant contributions to this effort. First thanks to Mike Crisler, N4IHD for writing A Beginners Guide To OSCAR-10, 1985, on which a large part of this booklet was based. Thanks also to Doug Howard, KG5OA for doing the graphics for this booklet on his Macintosh computer. Next, I would like to thank AMSAT Regional Coordinator Keith Pugh, W5IU for patiently "Elmering" myself and many others into amateur satellites. And also, thanks to AMSAT president Doug Loughmiller, K05I for giving me the opportunity to write this and serve AMSAT in any way that I may. Lastly, and most importantly, I would like to thank my wife Joan, who patiently edited and corrected "my gud engineers writ'en", even though very pregnant with our second child.

APPENDICES



AMSAT OSCAR-13

Mode B & Mode S Operating Frequency Guide

(Frequency in Megahertz)

Mode B		
<i>Uplink</i>	<i>Downlink</i>	Sum = 581.398 MHz
	145.985	Engineering Beacon
435.423	145.975	
435.433	145.965	
435.443	145.955	
435.453	145.945	
435.463	145.935	
435.473	145.925	
435.483	145.915	
435.493	145.905	
435.503	145.895	
435.508	145.890	Passband Center
435.513	145.885	
435.523	145.875	
435.533	145.865	
435.543	145.855	
435.553	145.845	
435.563	145.835	
435.573	145.825	Passband Lower Limit
	145.812	General Beacon

Mode S		
<i>Uplink</i>	<i>Downlink</i>	Diff. = 1965.113 MHz
435.636	2400.749	Passband Upper Limit
435.635	2400.748	
435.630	2400.743	
435.625	2400.738	
435.620	2400.733	
435.619	2400.732	Passband Center
435.615	2400.728	
435.610	2400.723	
435.605	2400.718	
435.602	2400.715	Passband Lower Limit
	2400.661	Engineering Beacon

NOTE: *Mode B is an inverting transponder. Standard convention is uplink on LSB and the downlink will be USB. However, Mode S is a non-inverting transponder. So uplink on USB and the downlink will be USB.*

AMSAT OSCAR-13

Mode JL Operating Frequency Guide

(Frequency in Megahertz)			
<i>L Uplink</i>		<i>Downlink</i>	Sum = 1705.356 MHz
	<i>J Uplink</i>		Sum = 580.413 MHz
1269.351		436.005	L Passband Upper Limit
1269.361		435.995	
1269.366	144.423	435.990	J Sub-band Upper Limit
1269.376	144.433	435.980	
1269.386	144.443	435.970	
1269.391	144.448	435.965	J Sub-band Center
1269.396	144.453	435.960	
1269.406	144.463	435.950	
1269.416	144.473	435.940	J Sub-band Lower Limit
1269.421		435.935	
1269.431		435.925	
1269.441		435.915	
1269.451		435.905	
1269.461		435.895	
1269.471		435.885	
1269.481		435.875	
1269.491		435.865	
1269.496		435.860	L Passband Center
1269.501		435.855	
1269.511		435.845	
1269.521		435.835	
1269.531		435.825	
1269.541		435.815	
1269.551		435.805	
1269.561		435.795	
1269.571		435.785	
1269.581		435.775	
1269.591		435.765	
1269.601		435.755	
1269.611		435.745	
1269.621		435.735	
1269.631		435.725	
1269.641		435.715	
1269.731	RUDAK Up	435.677	Engineering Beacon/ RUDAK Downlink
		435.651	General Beacon

NOTE: Mode JL is an inverting transponder. Standard convention is uplink on LSB and the downlink will be USB.

RADIO AMATEUR SATELLITE CORP.

P.O. BOX 27 -- WASHINGTON, DC 20044
AMSAT U.S.A. AREA COORDINATORS - NOV. 1989

CALL	NAME	ADDRESS	CITY & ZIP CODE	PHONE NUMBER
=====				
1ST CALL AREA				
K1LJL	WARLEY, STEPHEN	63 MOORE DRIVE	BURLINGTON, VT 05401	HOME (802) 658-3679
KAIM	DESKUR, DREW	19 PARKER DRIVE	NORTH READING, MA 01864-3014	HOME (508) 664-0009
N1BRQ	BESSETT, TIMOTHY	76 BARRETT ST.	SD, BURLINGTON, VT 05401	HOME (802) 863-6159
N1DBB	HAASIS, PAUL	6 DAVID ROAD	BILLERICA, MA 01821	HOME (508) 267-2618
W1IAS	POWER, TED	40 MASSACHUSETTS CT.	FALMOUTH, MA 02540	HOME (508) 548-1611
W1JSM	BROWN, DON	638 POST ROAD	GREENLAND, NH 03840	HOME (603) 436-6745
W1NU	POLITI, VICTOR D.	69 FLAX RD.	FAIRFIELD, CT 06430	HOME (203) 259-4655
W1IHM	TREMBLAY, DANA	216 HIGH RANGE RD.	LONDONDERRY, NH 03053	HOME (603) 432-0748
2ND CALL AREA				
WA2EXJ	BAKER, RANDY	P.O. BOX 144	MADISON, NY 13402	HOME (315) 893-7194
WB2IBO	MORTON, HARRY III	261 N. CHESTNUT ST.	MASSAPEQUA, NY 11758	HOME (516) 541-1783
WB2MNF	PEARCE, JON	109 PINE CONE TRAIL	MEDFORD, NJ 08055	HOME (609) 953-1677
WB2YGA	BANVILLE, VINCENT	RD 1 BOX 234 RT6	WAYMART, PA 18472	HOME (717) 253-5201
WD2ADC	WOODYARD, BRIAN	322 S. SERIVE RD.	MELVILLE, NY 11747	HOME - UNKNOWN -
3RD CALL AREA				
K3JL	LOW, JOHN	RT. 2 - BOX 2446	GEORGETOWN, DE 19947	HOME (302) 856-2307
K3PTQ	CROLL, MILLARD	435 HUGHES ROAD	KING OF PRUSSIA, PA 19406	HOME (215) 964-0422
W3KH	RUPERTO, E. F.	RD 1 BOX 366	WEST ALEXANDER, PA 15376	HOME (412) 663-5004
WA3GOV	ZISERMAN, HOWARD	11 WELHAVEN CIRCLE APT.1037	OWINGS MILLS, MD 21117	HOME (301) 581-9057
4TH CALL AREA				
W3PM/4	MARCUS, GENE	P.O. BOX 14114	HUNTSVILLE, AL 35810	HOME (205) 880-1237
K4BQH	SCHILLER, DICK	5208 SUMMIT VIEW LANE	CRESTWOOD, KY 40014	HOME (502) 222-0586
K4EDU	ROBINSON, ROY	3058 ANGELA STREET	AUGUSTA, GA 30907	HOME (404) 860-3090
K4SR	BISHOP, RICHARD	305 LAKEWOOD DRIVE	MONETA, VA 24121	HOME (703) 297-5550
KA4UFM	MIRACLE, DAVID	2083 GIULT CT.	LITHONIA, GA 30058	HOME (404) 987-5982
KB4AKQ	MYERS, BOB	346 PARKDALE DRIVE	CHARLESTON, SC 29407	HOME (803) 556-5022
KB4AIH	CHAMPION, LARRY	9427 MOUNT. SHADOWS DR	CHATTANOOGA, TN 37421	HOME (615) 892-7875
KE4ZV	HOFFMAN, GARY	534 SHANNON WAY	LAWRENCEVILLE, GA 30245	HOME (404) 963-8363
KG6EX/4	PENTECOST, GENE	2017 CEDERMONT DR.	FRANKLIN, KY 37064	HOME (615) 794-3496
KI4EA	SOLOMON, MARVIN D	14 CARJEN AVE.	ASHEVILLE, NC 28804	HOME (704) 258-1165
KJ4BF	BARNETT, LEE	701 E. CURTIS ST.	SIMPSONVILLE, SC 29681	HOME (803) 967-3963
NA1QV	SURFACE, TERRY	RT. 1 BOX 638	SUGAR GROVE, VA 24375	HOME (703) 677-3686
N4KJB	SANDS, GREG	14107 S.W. 55TH STREET	MIAMI, FL 33175	HOME (305) 554-5882
N4KHG	CALLIHAN, MIKE	9905 121ST COURT	SEMINOLE, FL 34642	HOME (813) 866-4688
N4RAR	PENLAND, JAMES	427 PRINCETON WAY N.E.	ATLANTA, GA 30303	HOME (404) 321-5113
N4SXM	PRESTON, CHARLES	2285 TALLY DRIVE	CHAMBLEE, GA 30341	HOME (404) 455-8147
W4AMI	BARBEE, ROBERT W. JR	2989 CARNOUSTIE RD.	MEMPHIS, TN 38128	HOME (901) 357-4386
W4AUZ	SHEPHERD, WM. R.	325 TAYLOR DR.	LEXINGTON, KY 40505	HOME (606) 254-2347
W4BIW	LINDSEY, BYRON	1356 VISTA LEAF DR.	DECATUR, GA 30033	HOME (404) 636-7452
W4DAQ	JORDAN, MACK	P.O. BOX 1027	DENVER, CO 80202	HOME (303) 729-1225
W4FJ	MATHEWSON, TED	1525 SUNSET LANE	RICHMOND, VA 23221	HOME (804) 355-5118
W4KDP	WHITEHURST, ROBERT	25 ARCADIA	TUSCALOOSA, AL 35401	HOME (205) 553-1282
W4OCW	WILHOIT, KEN JR.	153 STONE MILL LANE	MARIETTA, GA 30064	HOME (404) 428-4913
W4QAU	STLUKA, EDWARD	2802 BRETT ROAD	HUNTSVILLE, AL 35810	HOME (205) 852-3850
W4TZV	STARNES, SHERMAN R.	RT. 1 - BOX 99	FRANKLINTON, NC 27525	HOME (919) 494-5169
W4ZPG	CLOWE, COL. JOHN	4144 INDIAN MANOR DR	STONE MOUNTAIN, GA 30083	HOME (404) 299-2030
WA4GSS	CURRY, RON	229 W. GREEN HILL ROAD	ASHLAND, KY 41101	HOME (606) 928-6672
WA4SXM	SMITH, GOULD	7605 NAVARRE DR.	KNOXVILLE, TN 37919	HOME (615) 691-2718
WB4URU	FITZ, HENRY	3354 KEGLER DRIVE	JACKSONVILLE, FL 32216	HOME (904) 737-3569
WB4ZXS	MCDONALD, JOHN	1511 PINEDA ST.	COCOA, FL 32922	HOME (407) 632-6669
WD4HWO	POWER, BRUCE	1321 NANCY DRIVE	TALLAHASSEE, FL 32301	HOME (904) 877-3635
WD4NAE	ADAMS, DON	P.O. BOX 348	PELHAM GA 31779	HOME (912) 432-8133
WD4PON	FORTE, ALFRED	9302 SPRING TERRACE	OCALA, FL 32672	HOME (904) 687-1518
KAS5MA/4	MILLER, MIKE	RT. 14 BOX 475	SEVIERVILLE, TN 37862	HOME (615) 428-5415
WB5PMR/4	BRINKERHOFF, AL	7357 WOODKNOT CT.	ORLANDO, FL 32811	HOME (407) 298-8419
W6OTE/4	ZOLLER, AL	545 WOODLINE CT.	ROSWELL GA 30076	HOME (404) 992-7123
WA9NEW/4	EGGERS, BRUCE	1141 N SPRING GARDEN CL.	RALEIGH, NC 27603	HOME (919) 779-0266
WB9OEP/4	PARK, STEVE	12122 99TH AVE.	SEMINOLE, FL 34642	HOME (813) 391-7515
W0CA/4	LAUB, NICK	3951 VOORNE STREET	SARASOTA, FL 33580	HOME (813) 355-4824
5TH CALL AREA				
N4EL/5	BEERMAN, RICHARD C.	10062 WARWANA	HOUSTON, TX 77080	HOME (713) 468-5021
KA5DNP	DOUGLAS, JACK	2019 WILLOW POINT DR.	KINGWOOD, TX 77339	HOME (713) 358-5172
KA5RMT	MANIAGO, R. G. MD.	12 COUNTRY CLUB ROAD	VERNON, TX 76384	HOME (817) 553-1447
KN5D	THANISCH, ROBERT	P.O. BOX 997	CORRALES, NM 87048	HOME (505) 898-3859
KT5U	REEVE, RUSTY	RT. #2 BOX 211-0	MCKINNEY, TX 75069	HOME (214) 442-1217
HC5Y	TEW, GEORGE	1209 SPRINGDALE DR.	JACKSON, MS 39211	HOME (601) 956-4724
WA5WHN	MILLER, JAY D.	4613 JUPITER N.W.	ALBUQUERQUE, NM 87107	HOME (505) 344-6734
WB5ZDP	BERGLUND, KEITH	2936 ELSINOR DR.	FT. WORTH, TX 76116	HOME (817) 244-5176
WD5GLD	RUHL, RICHARD	RT. 1 BOX 105-RR	KINGFISHER, OK 73750	HOME (405) 375-4843
W5CBT	BLANTON, KEN	4700 MATADOR TRAIL	AMARILLO, TX 79109	HOME (806) 355-3234
W5DS6	BULMAHN, HAROLD	3309 MAPLE AVE.	WACO, TX 76707	HOME (817) 754-2732
W5GEL	DOUGLAS, BOB	3435 FLOYD STREET	CORPUS CHRISTI, TX 78411	HOME (512) 852-2208
W5IU	PUGH, KEITH	P.O. BOX 121576	FORT WORTH TX 76121	HOME (817) 292-5633
WA9PZL/5	LEY, ROGER	2514 DEAS ST.	BOSSIER CITY, LA 71111	HOME (318) 746-0356

CALL	NAME	ADDRESS	CITY & ZIP CODE	PHONE NUMBER
6TH CALL AREA				
AA6NP	DAVIES, BENE	3450 BEN LOMOND PL.	LOS ANGELES, CA 90027	HOME (213) 937-7942
KH6JRB/6	NAKAYAMA, GARY	P.O. BOX 6700	SAN MATEO, CA 94403	HOME (415) 591-4896
KL7BRF/6	FAIL, JOHN	6170 DOWNEY AVE.	LONG BEACH, CA 90805	HOME (213) 531-4852
N60BF	WISNIOWSKI, JOHN	1706 ROANOKE ST.	PLACENTIA, CA 92670	HOME (714) 524-7345
NF6S	WORD, CHUCK	3944 DARTMOUTH WAY	LIVERMORE, CA 94559	HOME (415) 449-9195
W6GERB	GOBRICK, BOB	8825 ETCHEVERRY DR.	TRACY, CA 95376	HOME (209) 836-9260
W6H8V	STRONG, JUDD B.	185 SALINAS DRIVE	VACAVILLE, CA 95688	HOME (707) 446-4748
W6VGS	SOMERS, JACK	P.O. BOX 49751	LOS ANGELES, CA 90049	HOME (213) 478-1717
W6YDI	SMITH, DAVID R.	1451 E. VARTIKIAN	FRESNO, CA 93710	HOME (209) 432-0290
W6GFI	FORBES, ROSS	P.O. BOX #1	LOS ALTOS, CA 94022	HOME (415) 948-5193
W6LLO	GUIMONT, DAVID	5030 JULY ST.	SAN DIEGO, CA 92110	HOME (619) 275-1495
W6OVH	FULLER, GORDON	7756 TOLIA WAY	FAIROAKS, CA 95628	HOME (916) 961-0576
W6AMX	DITTMER, R. G.	7305D ALDALO STREET	HONOLULU, HI 96818	HOME (808) 422-5691
W6AMW	DALLESKE, ROBERT	P.O. BOX # 220	MCCLLOUD, CA 96057	HOME (916) 964-3154
W6HDO	BUTTSCHARDT, CLIFFORD	950 PACIFIC ST.	MORROW BAY, CA 93442	HOME (805) 772-2132
W67CJ/6	WRIGHT, ROBERT MD.	320 CANDLELIGHT DR.	SANTA ROSA, CA 95403	HOME (707) 571-8262
7TH CALL AREA				
WD4ECK/7	MITCHELL, STUART	3030 EL DORADO DR.	MEDFORD, OR 97504	HOME (503) 770-2835
K7SFM	DZIURDA, FRANK	225 WEST COYOTE DR.	CARSON CITY, NV 89701	HOME (702) 849-1841
K7ZQK	LEARY, HAL	3625 WATER HOLE ST.	LAS VEGAS, NV 89130	HOME (702) 645-4527
KD7WZ	KILLINGSWORTH, DR. L.M.	EAST 2704 PLAYER DRIVE	SPOKANE, WA 99203	HOME (509) 448-8028
K17L	PETERSON, STEPHEN	3791 S. 1860 EAST	SALT LAKE CITY, UT 84106	HOME (801) 278-2727
KL7ETZ	LEWIS, DAVE	309 WACHUSETTS	SITKA, AK 99835	HOME (907) 747-6948
W7FAB	SIAS, VAN	8132 CAPE ARAGO HWY.	CHARLESTON, OR 97420	HOME (503) 888-3341
W7KRC	NELSON, WALLY	P.O. BOX 394	BOUNTIFUL, UT 84010	HOME (801) 298-5390
W7RZY	ROYLANCE, HARRY	216 SO. M STREET	LIVINGSTON, MT 59047	HOME (406) 222-0655
8TH CALL AREA				
KASTSR	ELLISON, JOHN	#3 BERSON AVE.	WHEELING, WV 26003	HOME (304) 232-2667
K8MU	KOZIEL, LARRY	25820 FORTUNA	ROSEVILLE, MI 48066	HOME (313) 777-9524
K800	BROOME, WENDELL	2400 RUDGATE DR. N.W.	GRAND RAPIDS, MI 49504	HOME (616) 784-3579
N8AEG	TESSNEER, KENNETH	4575 ARROWHEAD TRAIL	ENON, OH 45323	HOME (513) 864-1156
N8ATB	BERMAN, JOSEPH H.	P.O. BOX U	ATHENS, OHIO 45701	HOME (614) 592-3931
N8DDO	TEEPLE, JIM	1230 WARD N. W.	WARREN, OH 44485	HOME (216) 399-7292
W8PGP	BURGGRAF, R. G.	980 PROSPERITY RD	WAYERLY, OHIO 45690	HOME (614) 947-5483
W8LAJ	MOORE, GERALD W.	114 ST. FRANCIS AVE.	TIFFIN, OHIO 44883	HOME (419) 447-6719
W8RYD	MARCHAL, JEROME	270 W. SHARON RD	CINCINNATI, OH 45246	HOME (513) 772-0724
W8IFM	SCHRIK, GERD	4741 HARLOU DR.	DAYTON, OH 45432	HOME (513) 253-3993
W8ZTV	KNOLLINGER, D. E.	RD 4 BOX 230	MOUNDSVILLE, WV 26041	HOME (304) 845-1301
W8YANQ/8	RAHN, BRUCE A.	410 CORONADO TRAIL	ENON, OH 45323	HOME (513) 864-5803
K8B1/8	ROOP, JIM	P.O. BOX 255	ALLEGAN, MI 49010	HOME (616) 673-2893
9TH CALL AREA				
K1FJ/9	JAWORSKI, FRANK	3923 OAKLEAF DRIVE	FORT WAYNE, IN 46815-5421	HOME (219) 484-3222
KA9QIK	BOESENBERG, EARL	791 THORTON LANE	BUFFALO GROVE, IL 60089	HOME (312) 394-9348
KD9QB	POSUE, RONALD M.	210 WESTMINSTER DRIVE	NOBLESVILLE, IN 46060-4243	HOME (317) 773-4936
K09Q	FILIPIAK, MICHAEL	2224 COOPER AVE.	SHEBOYGAN, WI 53083	HOME (414) 453-2461
K9NO	BOCCI, PAUL	23 W. 732 PINE ST.	ROSELLE, IL 60172	HOME (312) 351-5213
K9PVW	LEARNER II, K. O.	P.O. BOX 5014	KOKOMO, IN 46904	HOME (317) 453-2947
KE9I	G. JENDRASZKIEWICZ	5459 W. 83RD PLACE	CROWN POINT, IN 46307	HOME -UNKNOWN-
ND9T	KEARNEY, TIMOTHY	6421 WAYOTA COURT	FORT WAYNE, IN 46815	HOME (219) 485-9651
N9EZV	TENDICK, KEN	228 LUNDY LANE	SCHAUMBURG, IL 60193	HOME (312) 980-5530
N9HR	WRENSCH, TOM	N. 7900 HILLCREST ST.	CONDONOWOC, WI 53066	HOME (414) 567-7382
W9JUV	SCHROEDER, JOE	P.O. BOX 406	GLENVIEW, IL 60025	HOME (312) 724-8831
W9MXC	ROBERTS, LARRY	3300 FERNWOOD	ALTON, IL 62002	HOME (618) 465-2735
W9YCV	PETERSON, LESTER A.	9741 W. HOWARD AVE.	GREENFIELD, WI 53228	HOME (414) 321-4745
W9KNP	PIOVESON, BRADLEY A.	301 KIRSCH ST.	BENTON, IL 62812	HOME (618) 439-3702
W9QPB	FILMER, DAVID L. DR.	P.O. BOX 2077	WEST LAFAYETTE, IN 47906	HOME (317) 497-3007
K0RL/9	LILE, RONALD E.	2822 WOODSIDE DRIVE	QUINCY, IL 62301	HOME (217) 223-6698
0 CALL AREA				
W6IFW/0	OWENS, LEE	202 GREENTREE ROAD	ATCHISON, KS 66802	HOME (913) 367-4226
K9MMW/0	LUDTKE, BOB	406 YALE CIRCLE	GLENWOOD SPRINGS, CO 81601	HOME (303) 945-8722
KA000Q	ELDER, JERRY	3213 FOX HILL RD.	ST. CHARLES, MO 63301	HOME (314) 723-8112
KB0SW	HANSON, GARY	ROUTE 1 BOX 364	COLLBRAN, CO 81624	HOME -UNKNOWN-
KE0DX	RUSSEL, RAYMOND	8 SUNRISE DRIVE	WATERTOWN, SD 57201	HOME (605) 882-1064
KF0BH	MCINTIRE, TOM	1014 S. 9TH AVE	MARSHALTOWN, IA 50159	HOME (515) 753-6263
K0GA	ANDERSON, G. A.	5820 CHOWEN AVE SO.	MINNEAPOLIS, MN 55410	HOME (612) 922-1160
K0TA	JOHNSON, MURRAY J.	2027 3RD STREET	BROOKINGS, SD 57006	HOME (605) 692-9850
N0ERC	DEVRIES, DAVID	100 O'LEARY LANE	ROCK RAPIDS, IA 51246	HOME (712) 472-2764
W0BP	STEPHENS, DAVID	10330 W. 77TH DR.	ARVADA, CO 80005	HOME (303) 424-1168
W0BAKO	CARY, DALE	3012 18TH STREET S.	MOOREHEAD, MN 56560	HOME (218) 236-6324
W0BE	WHITE, JIM	6642 S. DOVER WAY	LITTLETON, CO 80123	HOME (303) 979-7151
W0BHU	COWDIN, DAVID	8325 S. YUKON ST.	LITTLETON, CO 80123	HOME (303) 972-0648
W0CY	MCKIM, JIM	1721 GLEN AVE.	SALINA, KS 67401	HOME (913) 827-2927
W0EDZ	JENSEN, ART	411 3RD STREET S.E.	JAMESTOWN, ND 58401	HOME (701) 252-3769
W0IT	BURGHARDT, STAN	315 10TH AVE. N. W.	WATERTOWN, SD 57201	HOME (605) 886-3737
W0QIN	CLARK, ROBERT	7710 GLASGOW DRIVE	EDINA, MN 55435	HOME (612) 944-1315
W0SL	WELCH, ROY D.	908 DUTCH MILL ROAD	MANCHESTER, MO 63011	HOME (314) 391-1127
W0ZZQ	BODENHAUSEN, MAX	ROUTE 1 BOX 643	HIGHLANDVILLE, MO 65669	HOME (417) 587-3690

WORLDWIDE AMSAT INFORMATION SERVICES

Service Area	Day	Time	Freq (MHz)	NCS (Primary)
<i>International</i>				
Space Education Net	Sa	Varies	145.960	K1PXE/AO-13
International	Su	19:00 Z	14.282	WDØHHU/N2IDD
International	Su	19:00 Z	21.280	W8GQW/W8JLE
Int'l Novice/Tech.	Su	19:00 Z	28.460	WB2YGA
South Pacific	Sa	22:00 Z	14.282	ZL1WN
South Pacific	Sa	22:30 Z	21.280	
European	Sa	10:00 Z	14.280	PAØDLO
<i>Regional</i>				
US East Coast	Tu	21:00 L	3.840	K4EDU/W4BIW
US Central	Tu	21:00 L	3.840	WØCY/WØRPK
US West Coast	Tu	20:00 L	3.840	W6HDO/KI6QE
<i>US</i>				
CA Los Angeles	We	20:00 L	145.460	W6FXN
CA Los Angeles	All	07:30 L	144.144	
CA Los Altos	Tu	20:00 L	147.150	WB6GFJ
CO Denver	We	20:00 L	147.225	AAØP WDØFVV/R
GA Atlanta	We	21:30 L	145.410	W4BIW W4PME/R
IL Chicago	We	19:30 L	146.880	WD9IIC K9GFY/R
MI Detroit	We	20:00 L	224.460	N8IWJ
TX Houston	Tu	22:00 L	145.450	WA5ZIB WB5RDK/R
TX Dallas/Ft. Worth	We	20:00 L	146.620	W5IU/WB5ZDP
FL Miami	Tu	20:00 L	146.925	N4IFD

AMSAT BBS Sysop: Jeff Wallach, N5ITU (214) 394-7438

AMSAT Hq Telephone Line: Martha (301) 589-6062

Note: Times are Z=Zulu & L=Local.

TRACKING SATELLITE OSCAR-13

DATE	Time	Az/El	Lng/Lat	Range/Ph/Md	PA/E/V	Dop.	ES	SSE
03FEB89	102623	182/ 0	99/-39	18772/ 24/B	108/0/V	-5831Hz	19	74
03FEB89	104623	178/12	96/-30	21284/ 32/B	95/0/V	-5739Hz	16	76
03FEB89	110623	177/21	95/-23	23690/ 39/B	85/0/V	-5384Hz	14	78
03FEB89	112623	178/28	96/-18	25918/ 47/B	78/0/V	-4934Hz	12	79
03FEB89	114623	180/34	98/-13	27946/ 54/B	71/0/V	-4460Hz	12	80
03FEB89	120623	184/39	100/-10	29769/ 61/B	66/0/V	-3988Hz	11	81
03FEB89	122623	188/44	103/ -6	31390/ 69/B	61/0/V	-3528Hz	10	83
03FEB89	124623	194/47	106/ -3	32816/ 76/B	57/0/	-3082Hz	10	84
03FEB89	130623	200/50	109/ 0	34053/ 84/B	53/0/	-2650Hz	9	85
03FEB89	132623	208/52	112/ 3	35105/ 91/B	50/0/	-2228Hz	9	85
03FEB89	134623	215/53	115/ 6	35977/ 99/B	46/0/	-1813Hz	9	86
03FEB89	140623	223/53	119/ 8	36670/106/B	43/0/	-1401Hz	9	87
03FEB89	142623	231/53	122/ 11	37186/114/B	40/0/	-990Hz	9	88
03FEB89	144623	239/53	125/ 13	37524/121/B	38/0/	-575Hz	9	89
03FEB89	150623	246/51	129/ 15	37681/129/B	35/0/	-153Hz	9	90
03FEB89	152623	253/50	132/ 18	37654/136/B	32/0/	280Hz	9	90
03FEB89	154623	259/48	135/ 20	37437/144/B	29/0/	729Hz	9	91
03FEB89	160623	265/46	139/ 23	37022/151/B	27/0/	1196Hz	9	92
03FEB89	162623	270/44	142/ 25	36401/158/B	24/0/	1689Hz	9	93
03FEB89	164623	276/43	145/ 28	35561/166/B	22/0/	2211Hz	9	94
03FEB89	170623	280/41	147/ 30	34487/173/B	19/0/	2770Hz	9	95
03FEB89	172623	285/39	150/ 33	33163/181/L	16/0/	3374Hz	10	96
03FEB89	174623	290/38	152/ 36	31567/188/L	14/0/	4034Hz	10	97
03FEB89	180623	295/37	153/ 39	29671/196/L	12/0/	4763Hz	11	98
03FEB89	182623	299/36	153/ 42	27443/203/B	11/0/	5580Hz	12	99
03FEB89	184623	305/36	152/ 46	24839/211/B	11/0/	6508Hz	13	101
03FEB89	190623	311/37	149/ 50	21804/218/B	15/0/	7577Hz	14	102
03FEB89	192623	318/40	141/ 54	18274/226/B	21/0/	8811Hz	16	104
03FEB89	194623	330/45	126/ 57	14182/233/B	32/0/	10145Hz	19	106
03FEB89	200623	357/53	99/ 55	9601/240/B	53/0/	10751Hz	25	107
03FEB89	202623	73/38	67/ 36	5998/248/0	107/0/	2794Hz	35	106
03FEB89	203752	103/ 0	51/ 13	6818/252/0	155/0/	-9144Hz	43	100

----- END OF PASS -----

Typical OSCAR-13 pass using Quiktrak version 3.2 on the IBM PC.

Note particularly the "Time" and the "AZ/EL" column.

The pass will always begin when the EL is zero (just rising above your horizon) and always end when the EL is again zero (just setting below your horizon).



ASSEMBLY INSTRUCTIONS

STANDARD CLAMP



NUT



WASHER
SPREAD



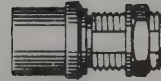
GASKET



CLAMP



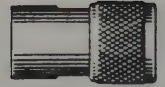
FEMALE
CONTACT



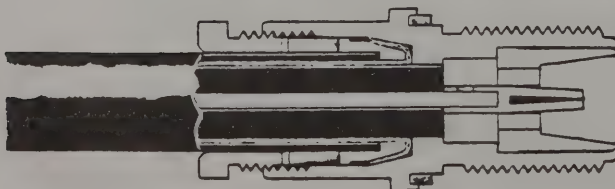
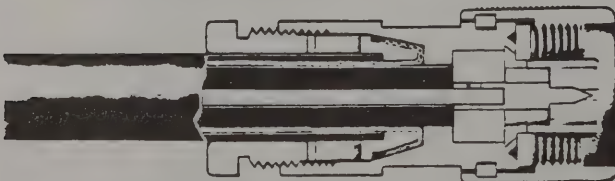
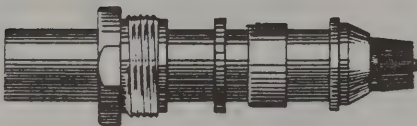
JACK BODY



MALE
CONTACT



PLUG BODY



Remove $\frac{9}{16}$ " (14.3mm) of vinyl jacket. When using double shielded cable, remove $\frac{7}{8}$ " (15.9mm).

Comb out copper braid as shown. Cut off dielectric $\frac{7}{32}$ " (5.6) from end. Tin center conductor.

Taper braid as shown. Slide nut, washer and gasket over vinyl jacket. Slide clamp over braid with internal shoulder of clamp flush against end of vinyl jacket. When assembling connectors with gland, be sure knife edge is toward end of cable and groove in gasket is toward the gland.

Smooth braid back over clamp and trim. Soft solder contact to center conductor. Avoid use of excessive heat and solder. See that end of dielectric is clean. Contact must be flush against dielectric. Outside of contact must be free of solder.

Slide body into place carefully so that contact enters hole in insulator. Face of dielectric must be flush against insulator. Slide completed assembly into body by pushing nut. When nut is in place, tighten with wrenches. In connectors with gland, knife-edge should cut gasket in half by tightening sufficiently.

NOTE: For armored cable slide cap over armor first. Push armor and cap back out of way and proceed with assembly as directed above using armor clamp in place of standard clamp nut. When assembly is complete straighten bulge in armor and trim so it can be clamped between nut and cap.

MIL-CLAMP I & MIL-CLAMP II

ASSEMBLY INSTRUCTIONS



NUT



GASKET



CLAMP



FEMALE CONTACT



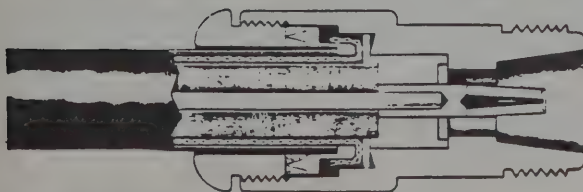
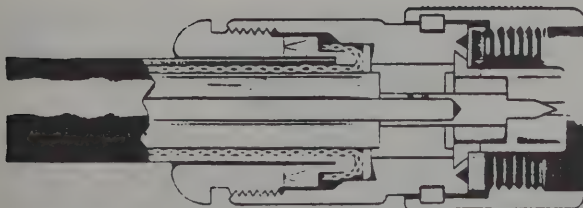
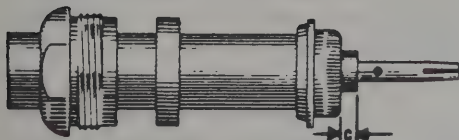
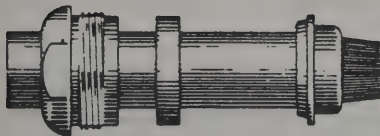
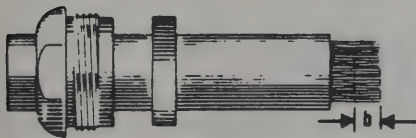
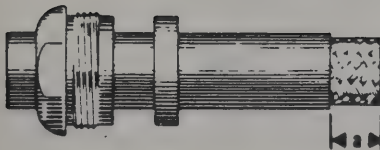
JACK BODY



MALE CONTACT



PLUG BODY



Stripping dims. $\pm \frac{1}{64}$ (0.4)
inches (millimeters)

	a	b	c (ref.)
MIL-CLAMP I			
35250	$\frac{9}{32}$ (7.1)	$\frac{5}{32}$ (4.0)	.045 (1.2)
35275	$\frac{29}{64}$ (11.5)	$\frac{3}{16}$ (4.8)	.130 (3.3)
	$\frac{9}{16}$ (14.3)	$1\frac{1}{64}$ (4.4)	.272 (6.9)
MIL-CLAMP II			
82-4352-1, 82-4356-1, 82-4360-1, 82-4364, 82-4357 & 82-4369	$\frac{9}{32}$ (7.1)	$\frac{5}{32}$ (4.0)	.045 (1.2)
82-4352, 82-4356, 82-4360, 82-4365 & 82-4368	$\frac{23}{64}$ (9.1)	$1\frac{1}{64}$ (6.0)	.045 (1.2)

Place nut and gasket, with "V" groove toward clamp, over cable and cut off jacket to dim. a.

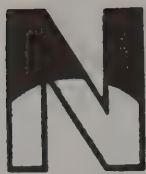
Comb out braid and fold out. Cut off cable dielectric to dim. b as shown.

Pull braid wires forward and taper toward center conductor. Place clamp over braid and push back against cable jacket.

Fold back braid wires as shown, trim to proper length and form over clamp as shown. Solder contact to center conductor.

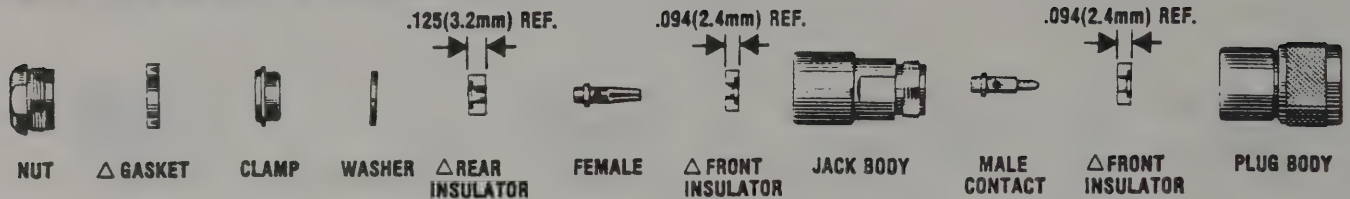
Insert cable and parts into connector body. Make sure sharp edge of clamp seats properly in gasket. Tighten nut.

NOTE: For armored cable slide cap over armor first. Push armor and cap back out of way and proceed with assembly as directed above using armor clamp in place of standard clamp nut. When assembly is complete straighten bulge in armor and trim so it can be clamped between nut and cap.

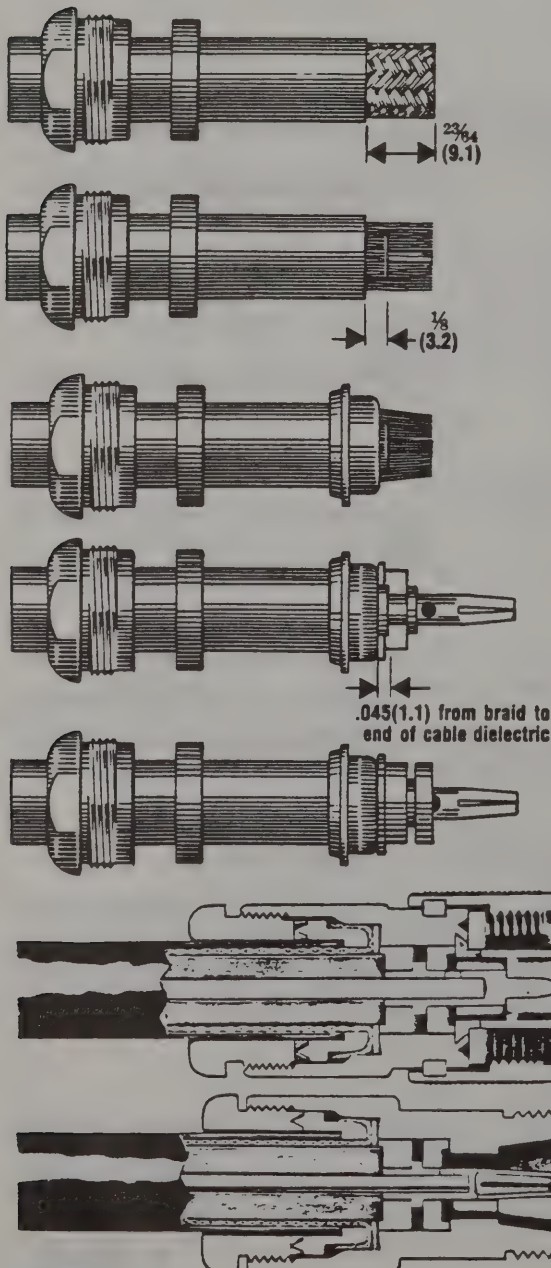


ASSEMBLY INSTRUCTIONS

C.C. CLAMP



△ CROSS SECTION VIEWS



Cut end of cable even. Place nut and gasket, with "V" groove toward clamp, over cable and cut off jacket $23\frac{3}{64}$ " (9.1mm) from end.

Comb out braid as shown. Cut off cable dielectric $\frac{1}{8}$ " (3.2mm) from end of jacket.

Pull braid wires forward and taper toward center conductor. Place clamp over braid and push back against cable jacket.

Fold back braid wires as shown, trim to proper length and form over clamp as shown. Tin exposed center conductor using minimum amount of heat. Slide on washer, rear insulator and contact. Contact shoulder, insulator, and cable core must butt as shown. Solder contact to center conductor.

Slide front insulator over contact. Be sure to place counter bore end of insulator toward mating end of contact.

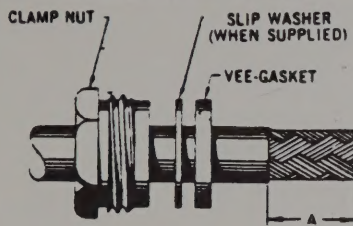
Insert prepared cable termination into connector body. Make sure sharp edge of clamp seats properly in gasket. Tighten nut, holding body stationary.

NOTE: For armored cable slide cap over armor first. Push armor and cap back out of way and proceed with assembly as directed above using armor clamp in place of standard clamp nut. When assembly is complete straighten bulge in armor and trim so it can be clamped between nut and cap.

■ Use Divco #276 (or other high temp. alloy) solder for high temp. applications.

CABLING PROCEDURE CP-1000

FOR "KINGS" Connectors



1. Cut cable end square, place clamp-nut, slip washer (when supplied), and gasket over jacket. Remove jacket to dimension "A."

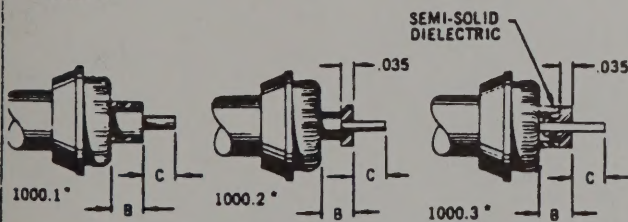


2. Comb out braid and taper forward. Place braid clamp over braid against jacket cut.



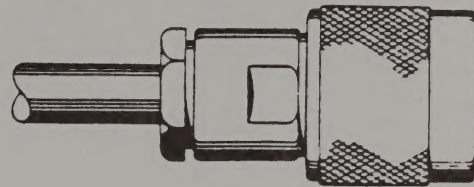
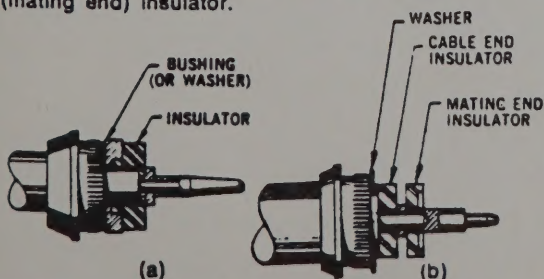
3. Fold braid back over braid clamp and trim as shown above. Remove dielectric to dimension "B." Cut center conductor to dimension "C."

When cable positioning insulators are used adjust trim code dimensions as shown below, and assemble as indicated.

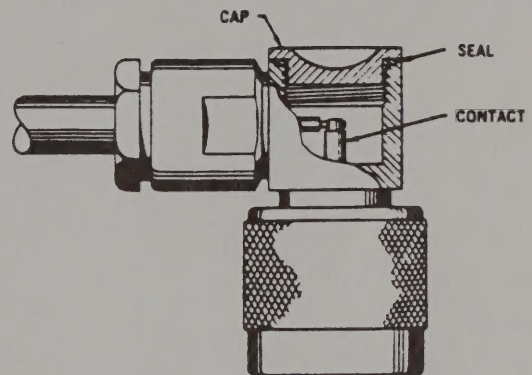


4. Solder contact to center conductor. For access type angle connectors, omit this step and proceed to step 5.

For captive contacts: (a) assemble bushing and insulator, attach contact, or (b) assemble washer and larger (cable end) insulator. Attach contact. Assemble smaller (mating end) insulator.



5. Thread assembly into connector, and lock securely. Vee gasket must be split by braid clamp.



6. For access type angle connectors, solder center conductor in contact groove. Close access opening.

TRIM CODE CHART

CODE	A	B	C
1004	11/32	.106	7/64
1005	11/32	.040	5/32
1006	3/4	.531	7/64
1007	1 1/16	.540	13/32
1008	3/8	.180	1/16
1038	25/32	.562	7/64
1039	1 3/64	.859	5/64
1042	5/16	.070	1/8
1050	19/64	.109	7/64

1024 3/8 046 3/16

*Use appropriate dimensions from trim code chart above.

This is the one usually found at Hamfest UG 210/u

